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A STUDY OF THE PHYSICAL PROPERTIES OF SOME SODIUM-BOROALUMINATE GLASSES

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Abstract

A study of the properties of some sodium-boroaluminate glasses was made in order to ascertain the field of glass formation and to determine the physical characteristics of such glasses.

The field of glass formation in the system (Na_2O-B_2O_3-Al_2O_3) was first located. Then a series of glasses was made in which the sodium oxide content was replaced by alumina on a molecular percentage basis while the boric oxide was held constant. The physical properties, expansion, viscosity, refractive index, and density were determined. The composition-property curves exhibited definite trends and variations over the range of substitution of Al_2O_3 for Na_2O. Attempts were made to explain the change in properties on the basis of change in the structure of the glass.

I. Introduction

In recent years much interest has been exhibited in silica-free glasses, both in the theory as well as in their practical application. Special emphasis has been placed on B_2O_3 and P_2O_5 glasses because they, like SiO_2, are known to be good glass formers. Although alumina is not considered to be a glass former, it can enter the glass network, especially in silica glasses, and can assume a coordination number of 4.

In this investigation, the physical properties of some Na_2O-B_2O_3-Al_2O_3 glasses were determined. An attempt was made to interpret these results on the basis of present-day theories of the structure of glass.

II. Structure of Na_2O-B_2O_3 Glasses

The investigations of Warren[1] and his co-workers[2] have shown that in vitreous B_2O_3 the coordination number of boron is 3, and the average B-O distance is 1.39 Å. Under certain conditions, however, boron may change from triangular to tetrahedral coordination, e.g. by the addition of Na_2O to B_2O_3 as indicated by Warren and Biscoe,[3] who studied three soda-boric oxide glasses containing respectively 10.3%, 20.6%, and 30.8% Na_2O. Their results indicated that the B-O distance changed from 1.39 Å in pure boric oxide glass to 1.37 Å, 1.42 Å, and 1.48 Å respectively in the three glasses mentioned above. Further, the coordination number of boron atoms changed from 3.1 in pure boric oxide glass to 3.2, 3.7, and 3.9 oxygens in the three glasses studied. These results explained the well-known boric oxide anomaly.

The structure of Na_2O-B_2O_3 glasses in general consists of a boron-oxygen network with each boron surrounded by three or four oxygens with sodium occupying the holes in the network.

III. Experimental Work

(1) *Field of Glass Formation.* The possible field of useful glasses in the system Na_2O-Al_2O_3-B_2O_3 was first studied. The (X) marks in Fig. 1 define the area originally covered in which the compositions shown were heated to 1300°C. and held for approximately 1 hour. The area bounded by triangle BDE (Fig. 1) appeared to give good glasses while those outside the triangle did not form complete glasses at the temperature investigated. Therefore, the area of useful glasses was confined to that bounded by triangle BDE. Glasses S_1 through S_7 were used for the study of physical properties because they represented good glasses within this field and afforded a means of studying the effect of replacement of sodium oxide by aluminum oxide. The amount of B_2O_3 in all these glasses was held constant.

(2) *Study of Physical Properties.* (a) *Preparation of Glasses:* In order that suitable samples for a study of physical properties might be prepared, the following procedure was used: Batches were made in units so as to produce 50 grams of glass. Baker's analyzed sodium carbonate, aluminum hydrate, and boric acid supplied the Na_2O, Al_2O_3, and B_2O_3 components. All melts were made in platinum crucibles at a slow rate of heating to the melting temperature in order to minimize mechanical losses and volatilization. To refine the glasses, the melts were then transferred to an electric muffle furnace (Kanthal) where the molten glass was stirred by a platinum rod every 15 minutes for two hours. Rods and fibers for

physical tests were drawn from these melts, while the remainder of the glass was poured into molds to form lenses, approximately 1½ inches in diameter. All rods and lenses were annealed in an electric muffle furnace (nichrome) by slow cooling from 850°F. (454°C.). This step was based on previous knowledge of low-temperature viscosity data on these glasses. Under polarized light, these samples showed a uniform distribution of strain. The percentage molecular composition of these glasses is given in Table I.

Because mechanical and volatilization losses are recognized to be caused by the large area of exposed surface during melting and by the velocity of air, precautions were taken to minimize this effect following procedures suggested by Turner.[4] Slow melting and sintering in the restricted area of a small, covered platinum crucible tended to reduce these losses.

TABLE I

Percentage Molecular Composition of the Glasses

	S_1	S_2	S_3	S_4	S_5	S_6	S_7
B_2O_3	65	65.0	65	65.0	65	65.0	65
Na_2O ...	35	32.5	30	27.5	25	22.5	20
Al_2O_3 ..	—	2.5	5	7.5	10	12.5	15

(b) *Softening Point:* Softening points of the samples were measured by Littleton's[5] fiber-elongation method. The results of this test are shown in Fig. 2.

(c) *Annealing and Strain Point:* The annealing and strain points were determined by the Lillie[6] fiber-elongation method under load (Fig. 3).

(d) *Thermal Expansion:* Thermal-expansion tests were made by a modified dilatometer method using a quartz tube. The scale and optical lever device made the measurements more sensitive (Fig. 4).

(e) *Density:* Density was determined by the displacement method using carbon tetrachloride as the immersion medium. The results were corrected for loss in weight of wire immersed and for the buoyancy of air and referred to water at 4°C. (Fig. 5).

(f) *Refractive Index:* The refractive index was determined by a powder-immersion method in which the indices of certain oils were varied by means of careful temperature control. When the proper match of oil and

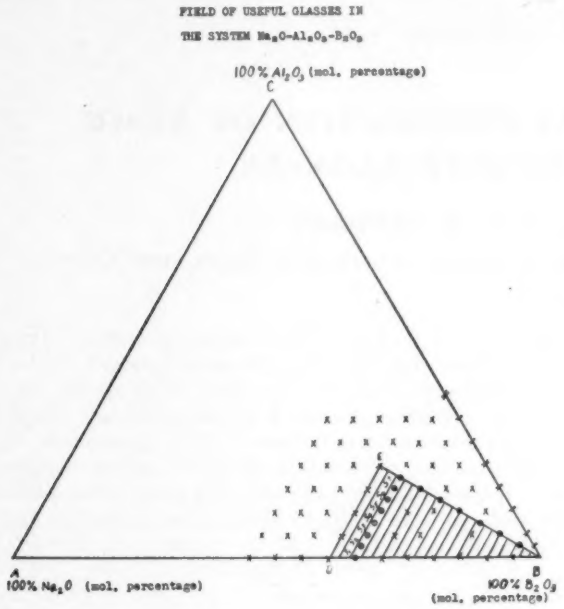

Fig. 1

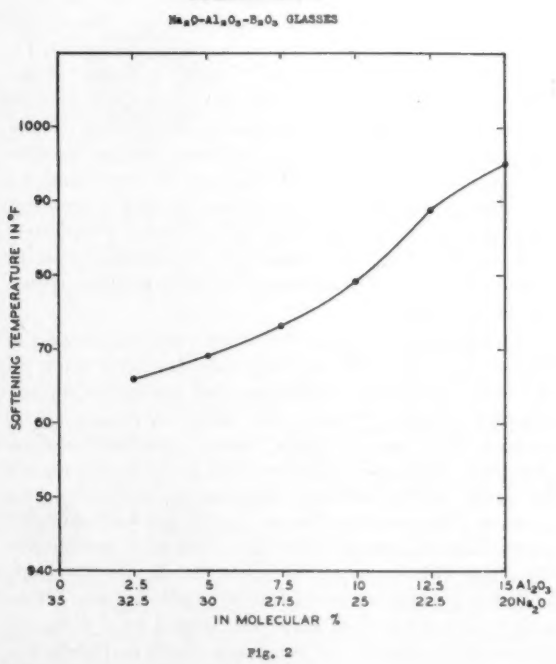

Fig. 2

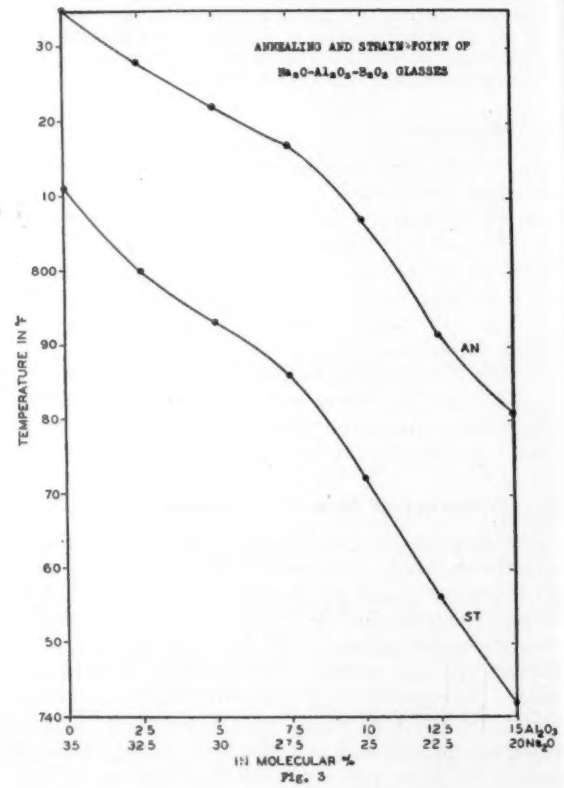

Fig. 3

powdered sample was attained, the suspended glass particles could not be distinguished in the immersion oil. Accurate index of the comparing oil at the attained temperature was then made with an Abbe refractometer. Temperatures were controlled by circulating pre-heated water through a heating coil and rheostat (Fig. 6).

IV. Discussion of Results

According to Warren and Biscoe[3] the coordination number of B^{+3} is 4 with base glass S_1. In these experiments Al_2O_3 was substituted for Na_2O and, therefore, weak Na-O bonds were being replaced by the stronger Al-O bonds. Field strengths[7] of Al-O are 0.96 for 4-fold coordination and 0.84 for 6-fold, while that of Na-O is 0.19. This higher value results in a stronger structure with a resultant increase in the softening point and decrease in thermal expansion of the glasses.

The density and refractive index were shown to decrease as Al_2O_3 replaced Na_2O. The decrease in density indicated an expanding network. This expansion may be explained on the assumption that Al^{+3}, instead of entering the network modifying position of Na^{+1}, entered the network proper and assumed 4-fold coordination.

Tightening of the bonds decreases the index of refraction, while loosening them allows greater freedom for the electrons of the oxygen to respond to the electric field of the light waves, therefore increasing the index of refraction. In the glasses mentioned above, there was a strengthening of structure with a resulting decrease of refractive index.

Further conclusion regarding the interpretation of physical properties in this interesting field of silica-free glasses can be made only after additional investigation, especially in the sytem Na_2O-Al_2O_3-B_2O_3.

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DENSITY OF Na_2O-Al_2O_3-B_2O_3 GLASSES

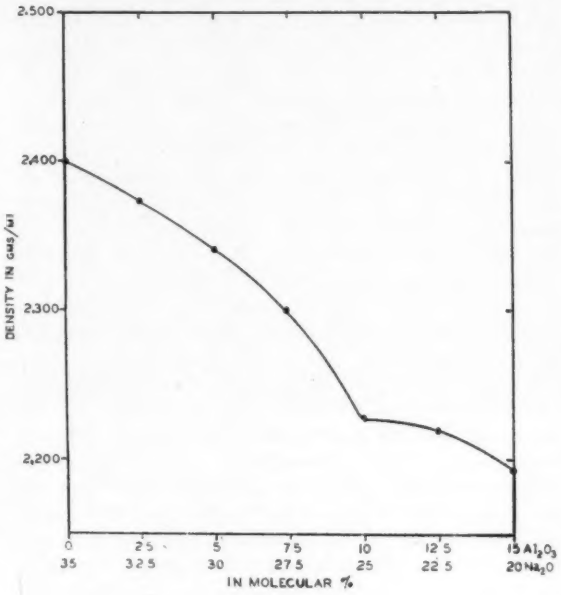

Fig. 5

THERMAL EXPANSION OF

Na_2O-Al_2O_3-B_2O_3 GLASSES

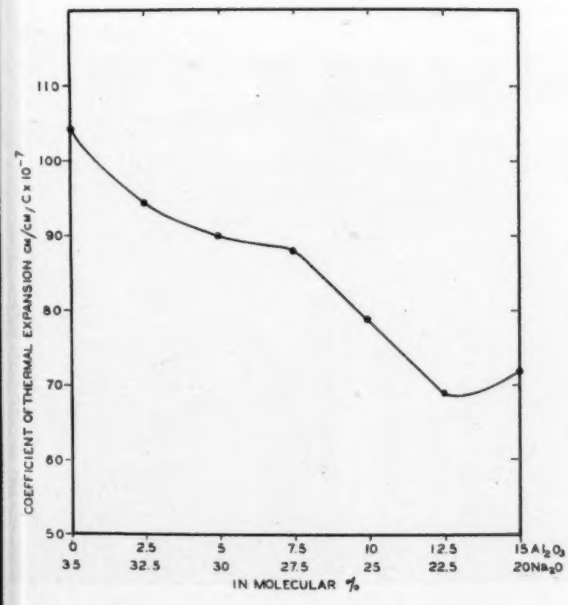

Fig. 4

REFRACTIVE INDEX OF

Na_2O-Al_2O_3-B_2O_3 GLASSES

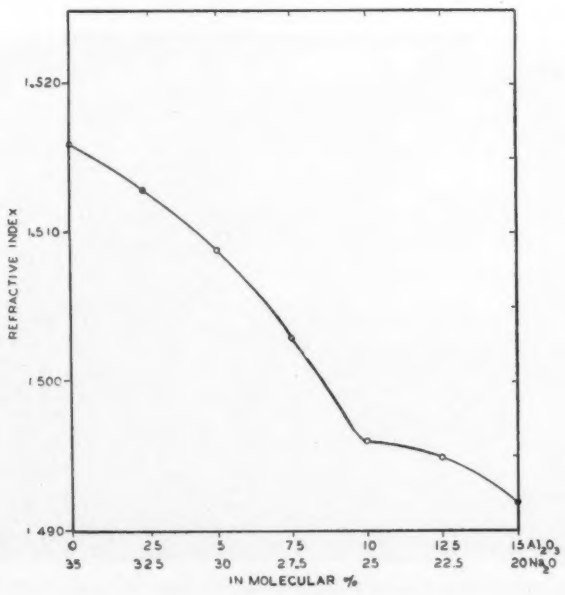

Fig. 6

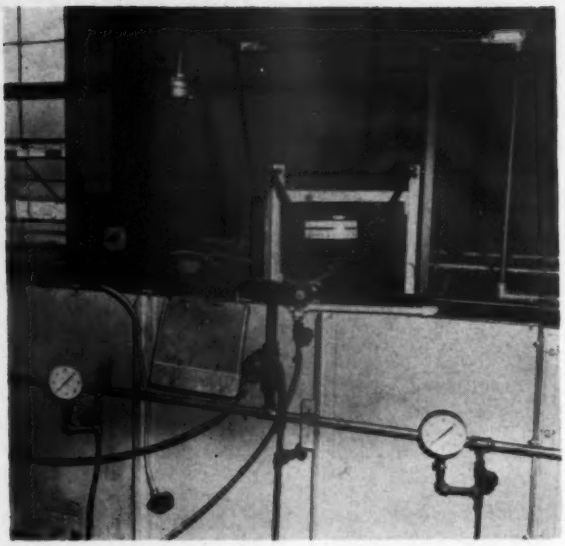

Fig. 6. Lehr temperature indicator with nine-point rotary switch.

combustion air temperature are recorded on a two-pen Brown instrument.

Feeder Temperatures Closely Controlled

The tank has five gas-fired Hartford-Empire feeders which supply the glass forming machines. The temperature in these feeders is very critical as on it, as well as on the glass level, depends the control of product weight. Each feeder is divided into a channel zone and a spout zone. Each zone is equipped with a radiation pyrometer sighting directly on the molten glass. These units measure the temperature which is indicated and recorded by two circular chart electronic potentiometers at the machine operator's station. The potentiometers control the gas supply to the channel and spout burners, respectively, to maintain the exact desired temperature.

Radiation pyrometers were chosen at the Diamond Glass Company over the more commonly used thermocouples because of their extemely high speed of response, sensitivity, and accuracy and because the installation and maintenance problem is materially less. Temperature of the molten glass at the spout is thus maintained within very close tolerances.

Feeder Temperature and Glass Level Determine Product Weight

The importance of exact temperature and level control in the feeders cannot be over-emphasized. Variations result in too large or too small a gob which, in turn, results in variations in product weight, a major cause of rejects. Too much or little weight means a variation in fluid capacity so that, in the case of bottles filled by automatic machinery, the fluid level in the necks will vary, resulting in poor customer acceptance of the product.

Lehr Controls Increase Strength

From the forming machine, the now completed containers enter the annealing lehrs. This is a very im-

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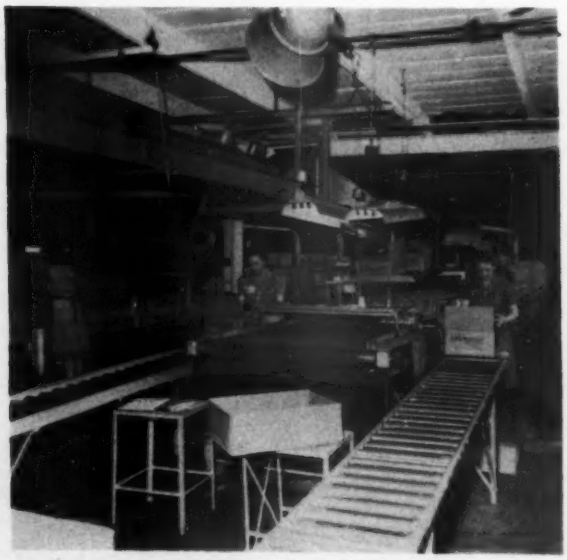

Fig. 7. Inspection and packaging. Chain Belt conveyor carries ware through lehr to inspection and packaging tables.

Fig. 8. Glass level probe mechanism.

OWENS-ILLINOIS ESTABLISHES THE LEVIS AWARD FOR SAFETY

By H. V. GARDNER, Safety Director

Glass Container Division, Owens-Illinois Glass Company, Toledo, Ohio

Owens-Illinois Glass Company, long a practicing believer in industrial safety promotion, is producing results through establishment of its own safety award for various manufacturing units. Genuine results of any safety program are, of course, measured in terms of effective elimination of human suffering and reduction of cost in both dollars and production.

A program of this type gives emphasis to the unending efforts of the National Safety Council. At the same time, it lifts a financial burden from the Council which understandably has been forced to limit its Distinguished Service for Safety Award because of the high cost involved in presenting suitable plaques to the many eligible plants throughout the United States.

After Owens-Illinois decided to establish its own award, the promotion was given impetus for all the divisions of the company when W. E. Levis, Chairman of the Executive Committee, and J. P. Levis, Chairman of the Board of Directors, gladly granted permission to use the Levis name on the award. Plans were immediately drawn up to put the program in effect.

Thus the Levis Award For Safety came into being. Briefly, here is how it works: O-I's Industrial Relations Committee weighs the non-accident records and passes upon the plants that have earned the award. An eligible plant receives a plaque, which serves as a permanent record and is a symbol of plant-wide pride. In addition, each person in the plant is eligible to receive a set of drinking tumblers manufactured by the Libbey Glass Division of the company. These Libbey Safedge tumblers are appropriately decorated with the Green Cross for Safety.

O-I's industrial relations people feel that safety is a blessing all too often taken for granted until a mishap occurs. Promoting "safety consciousness" at the "take-home" level therefore has an immeasurable worth. A letter from the plant manager accompanies each set of tumblers. This letter is congratulatory and in it the plant manager thanks the employees for their part in the non-injury record.

Rules of eligibility for the award were announced in the O-I plant newspapers at the program's inception eight months ago. Continuing safety features, pictures, and a progress report are established editorial content. When a plant earns the award, congratulatory messages from the general factories manager, company safety director, and plant manager are published with good display.

In addition to plant newspaper publicity, the Levis Award For Safety is promoted by bulletin boards, special stunts, and display of award tumblers in a well-trafficked spot in the plant. Safety Committees composed of plant members and led by the plant safety director also play an important part.

Another example of giving safety a personalized twist is shown by the fact that each foreman presents the glassware to members of his shift. Owens-Illinois is especially anxious to tie in the foreman with this program. In an award plant, for example, each foreman personally tells his people that they will receive a fine set of glassware because of the excellent safety record they helped to compile for the plant. This gives the foreman, a key person in safety, another opportunity to "sell safety" to his people.

An Owens-Illinois manufacturing unit becomes eligible for the Levis Award For Safety if: (1) the plant works a period of one million man-hours without a lost-time accident; (2) the plant has worked twelve consecutive months without a lost-time accident, providing it has worked two hundred thousand man-hours in the year. (If the plant or unit is too small to accumulate two hundred thousand man-hours in twelve consecutive months, it may earn this recognition by continuing until it has worked two hundred thousand accident-free man-hours.)

All lost-time accidents and safety records comply with the American Standards Association's method of compiling industrial injury rates, which is used in all plants at the present time. A list of rules has been set up for the purpose of helping the Industrial Relations Committee determine the plants that are eligible for the award. These are as follows:

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Jane Sturdivant, Secretary to Safety Director H. V. Gardner, displays a set of the award tumblers with the Green Cross of Safety permanently fused into the glass. Each member of an Owen-Illinois plant winning the Levis Award For Safety is automatically eligible to receive a set of these tumblers as part of the "take home" promotion of the award.

RECENT TRANSLATIONS OF RUSSIAN PAPERS OF INTEREST TO THE GLASS INDUSTRY

Abstracts of two papers which appeared in the Russian journal of the glass and ceramic industries.

MECHANICAL AND CHEMICAL PROPERTIES OF GLASS CHARGE BRIQUETS

A study of the above problem has been recently published by M. A. Khachvankyan in *Steklo i Keramika* (Glass and Ceramics) *8*, No. 1, 3-7 (1951).

Two batches were used. Their compositions were: *Soda batch:* sand 73, sodium carbonate 30.0, sodium sulfate 1.3, chalk 2.0, and dolomite 17.3 weight units. *Sulfate batch:* sand 73, sodium carbonate 7.05, sodium sulfate 24.06, chalk 2.0, and dolomite 17.3 weight units.

Briquets of these batches were made in an ordinary brick press. They all were 70x125x260 mm. (2.76x4.92x 10.2 inches) but differed in their moisture content and in the pressure used during the briqueting. Water without any addition was the binder employed.

The apparent density of the briquets, i.e., their mass divided by the total volume of the briquet, was greater the greater the moisture content and the pressure of briqueting. This is seen in Fig. 1 and Fig. 2. The abscissae of these figures represent the briqueting pressure in kg.wt./ sq.cm. (multiply by 14 to obtain pressures in lb./sq.in.) and along the ordinate the apparent density (grams/ cu.cm.) is plotted.

In Fig. 1, curve 1 refers to bricks containing 2.5% moisture, curve 2 to 6.28% moisture, and curve 3 to 10.34% moisture. The briquets were made of the soda batch. The briquets reported upon in Fig. 2 were made of the sulfate batch. They contained 2.5% moisture (curve [1]) or 7% moisture (curve 2).

It is seen that apparent density increases with briqueting pressure, first rapidly and then, above 200 kg.wt./ sq.cm., slowly. If d_a is the apparent density and P the pressure, along the first part of the curve d_a seems to be proportional to P^n, n being a constant exponent.

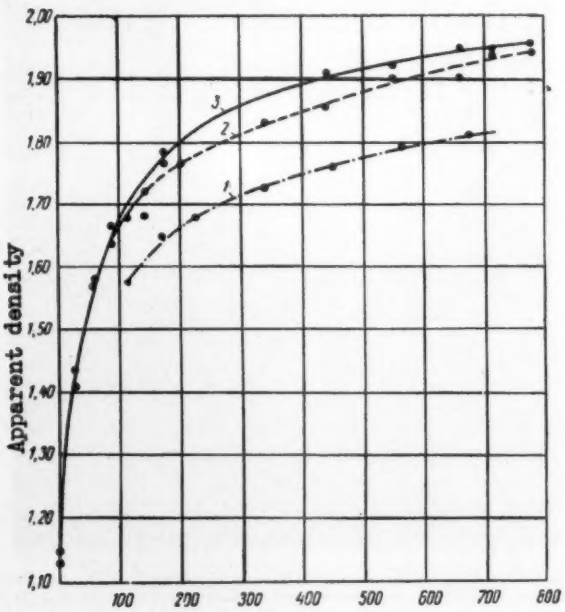

Fig. 1.
Briqueting pressure, kg.wt/sq.cm.

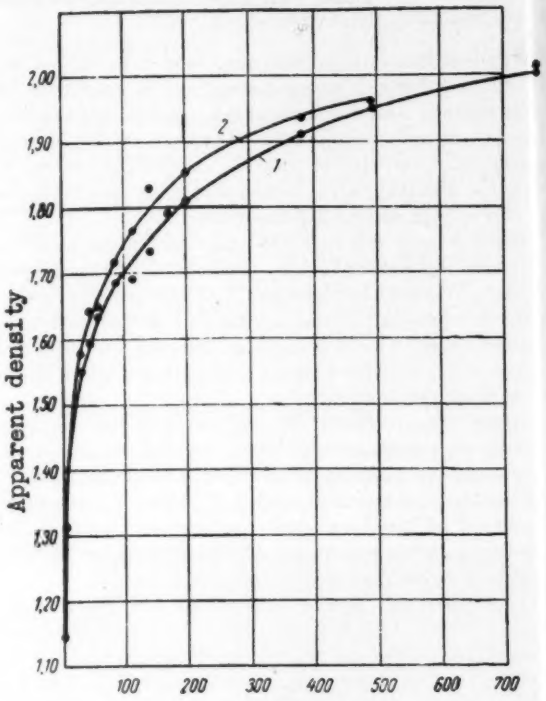

Fig. 2.
Briqueting pressure, kg.wt./sq.cm.

The increase of d_a on increase in P is due to decrease in pore volume. High pressure crushes batch particles and partially fills the original pores with the newly formed fragments. The relative pore volume can be calculated from d_a and the real density d_o of the material using the equation:

$$v = 100\ (1 - \frac{d_a}{d_o}),$$

in which v is the volume of voids in 100 volumes of the briquet. The real density of the material was determined for the soda batch, moisture content 6.28%, by measuring the volume of petroleum ether displaced by unit weight of the batch.

Fig. 3 shows the result of the calculations. The porosity v is plotted along the abscissa, and the briqueting pressure in kg.wt./sq.cm. along the ordinate. It is seen that at small pressures the porosity is over 50%, i.e., more than half of the total volume is occupied by voids. At the highest pressure used (750 kg.wt./sq.cm.) the porosity is only 25%, i.e., three quarters of the volume is occupied by solid particles.

The porosity was determined also in another manner.

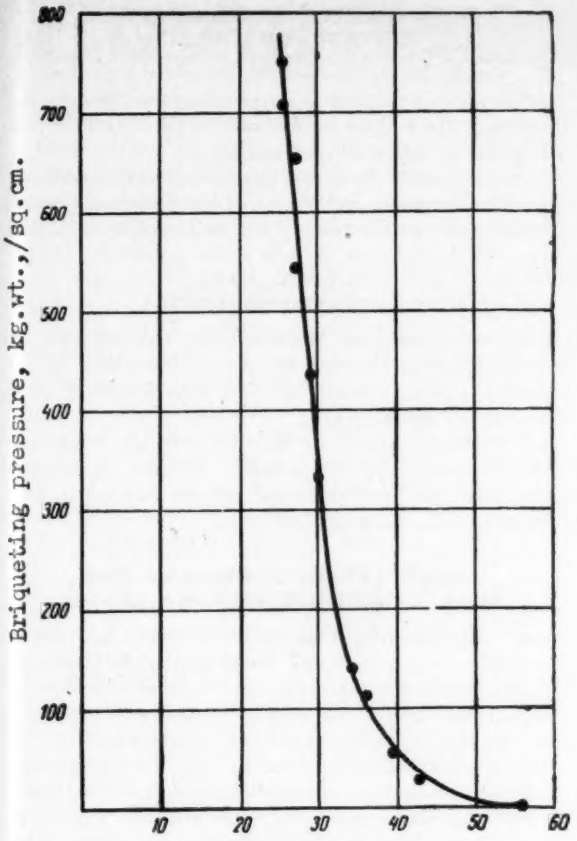

Fig. 3.
Porosity, vol. per cents.

Air was replaced in the briquet by carbon dioxide, and then the volume of carbon dioxide was measured. These porosity values agreed within 3-5% with those calculated from the above equation. This agreement proves that practically all the pores in the briquets are open; only few voids, if any, have no connection with the outside air. Therefore, escape of gases and of alkali from briquets in a glass furnace may be expected to be similar to that in a loose charge.

The mechanical strength of the briquets is due to formation of crystals of hydrated sodium carbonate and hydrated sodium sulfate. These crystals form soon after the moistening of the batch. Therefore, the batch should be pressed at once after moistening; then, crystallization proceeds in the briquets only. The strength of briquets immediately after compression is very small, although sufficient for transporting them from the press to the storage pile. As crystallization of the hydrates proceeds further, the strength gradually increases. This is illustrated in Table I. It demonstrates the increase of the resistance to compression of a briquet for several hours after formation.

The resistance to compression of a fresh briquet is greater the greater the briqueting pressure. Thus, briquets made under 64, 128, and 670 kg.wt./sq.cm. pressure showed resistance of 5.6, 6.9, and 44 kg.wt./sq.cm. The briqueting pressure of the samples of Table I was 128 kg.wt./sq.cm.

TABLE I
Resistance to compression of briquets aged for different times.

Aging for ...	0	10	15	20	25	30	40	50	210	310
	minutes									
Resistance ...	6.9	7.8	8.8	10.3	9.8	9.8	10.8	10.3	10.8	10.8
	kg.wt./sq.cm.									

Another aging process also occurs in the briquets. It is much slower than the crystallization of the hydrates and consists in absorption of carbon dioxide and conversion of sodium carbonate into sodium bicarbonate. In briquets it is a little quicker than in the loose batch. This is seen in Table II.

TABLE II
Concentration of $NaHCO_3$ (%) in batch and briquets containing 6% moisture.

Aging for	0	1	2	3	5	8	days
In loose batch	0	0.97	1.90	2.24	2.35	2.75	%
In briquets	0	1.06	1.15	2.13	2.78	3.30	%

The high bicarbonate content of the aged briquets has a disadvantage. The briquets, when placed on the surface of molten glass in a furnace or a pot, evolve large volumes of foam. Thus, briquets should be used soon after formation.

THERMAL EXPANSION OF REFRACTORIES

N. V. Solomin, N. M. Galdina, and N. A. Fridlender determined the coefficient of thermal expansion of several refractories used in glass industry and reported their results in *Steklo i Keramika* (Glass and Ceramics) *8*, No. 3, p. 8-11 (1951).

For the measurements the differential dilatometer constructed by Solomin was used. A bar of the material to be tested was placed in a trough next to a bar of standard material. One end of each of these parallel bars was in contact with the wall of the trough, while the other ends were in contact each with a porcelain tube whose other end carried a metal pointer. The trough and a part of the porcelain tubes were kept in an oven while the other part of the porcelain tubes and the pointers were outside the oven. The distance between the pointers was measured with a microscope. On increasing the temperature of the oven, it remained constant if the coefficients of thermal expansion of the two bars were identical; it increased or decreased according to whether the expansion of the test material was greater or smaller than that of the standard.

As the standard, synthetic corundum (α-Al_2O_3) was selected. The expansion calculated for bar of unit length at O°C. was at

20°	100°	300°	500°	700°	900°	1000°	1100°C.
14	64	201	364	540	730	832	938×10^{-5}

This means, e.g., that bar having the length of 1000 millimeters at 0°C. was 1009.38 mm. long at 1100°C.

Bars made of kaolin and of chamotte (from clay) at 1450°C. had the following linear coefficients of thermal expansion:

	kaolin	chamotte
between 20° and 500°C.	372×10^{-8}	350×10^{-8}
between 20° and 800°C.	410×10^{-8}	390×10^{-8}
between 20° and 1100°C.	460×10^{-8}	477×10^{-8}

(*Continued on page* 530)

TWELFTH CONFERENCE ON GLASS PROBLEMS ANNOUNCED

The Twelfth Conference on Glass Problems will be held at the University of Illinois, Urbana, Illinois, on Thursday and Friday, December 6 and 7, 1951.

Of the two-day conference program, one day is to be devoted to problems and new developments in the hand-made glass field (both pressed and blown), one-half day to batch handling and feeding, and one-half day to the theory, organization, and direction of training programs in the glass industry.

Any communications relating to the conference should be addressed to Dr. F. V. Tooley, Department of Ceramic Engineering, University of Illinois, 208 Ceramics Building, Urbana, Illinois.

B. H. TAYLOR DIES SUDDENLY

Bismark H. Taylor, Traffic Manager of the Glass Container Manufacturers Institute, died suddenly of a heart attack at his home.

Mr. Taylor was a former Vice President and General Traffic Manager of the Denver, Rio Grande & Western Railroad. He started his railroad career in 1911 with the Norfolk & Western Railroad and during World War I served with the United States Quartermaster Corps. After leaving the Denver and Rio Grande, Mr. Taylor joined the Burlington Railroad as assistant freight traffic officer.

Surviving are his wife, Mrs. May Jacobs Taylor; two sisters, Mrs. A. G. Horton and Mrs. F. K. Mays, and a brother, George W.

MEMBERSHIP OF NPA SHEET AND PLATE GLASS COMMITTEE

The National Production Authority has announced the membership list of the Sheet and Plate Glass Industry Advisory Committee as follows: A. S. Crandon, President of American Window Glass Company; R. J. Dognaux, President of Blackford Window Glass Company; W. R. Loughran, Director of Purchasing of Ford Motor Company; Russell Rice, President of Fourco Glass Company; A. L. Pasquier, President of Franklin Glass Corporation; G. P. MacNichol, Jr., Vice President of Libbey-Owens-Ford Glass Company; and R. B. Tucker, Executive Vice President of Pittsburgh Plate Glass Company.

NEW PROCESS DEVELOPED FOR COLOR TV TUBE

Two patents have been assigned to Sightmaster Corporation involving the processing of cathode ray tubes for color to permit a true and intensified translation of all colors of the spectrum evenly.

The patents also provide processes for filtering light to increase the contrast value of the television picture. This is accomplished by means of an evaporation and metal deposition process on glass. Also provided by these processes are methods for construction of non-glare windshields and visors in the automobile field.

The processes apply to any system of color television and are the culmination of two years' intensive work and research. The development and use of these patents are expected not only to affect the television field, but may influence the design of windshield and headlight construction in future cars.

W. RONALD LESTER JOINS PITTSBURGH CORNING

W. Ronald Lester has joined the Pittsburgh Corning Corporation, according to a recent announcement by that company. He will act as Assistant to the Executive Vice President on manufacturing matters.

Formerly with Dominion Minerals Incorporated, Mr. Lester is a member and Fellow of the American Ceramic Society and past chairman of the society's Glass Division.

G.C.M.I. FALL INDUSTRY MEETING

The Glass Container Manufacturers Institute has announced its Fall Meeting to be held November 28, 29, and 30 in Miami Beach, Florida, with headquarters at the Sea Isle Hotel.

Semi-annual reports by the nine standing committees will be received by the Board of Trustees. A Program Committee has been appointed and the full schedule of activities will be announced shortly.

NEGOTIATIONS UNDERWAY FOR SODA ASH PLANT IN NOVA SCOTIA

A new huge chemical plant to produce soda ash may be established at Antigonish, Nova Scotia. A large salt deposit beside a bed of limestone, together with the vast coal supplies available nearby in Cape Breton or Picton, may be used for such manufacturing purposes.

It is understood that negotiations are now proceeding with such an objective to establish a soda ash plant there. It would produce about 200 tons daily and require an investment of $6 million, though no companies interested in the project have been named. Sole producer of soda ash in Canada at present is Brunner Mond Canada, Ltd., Amherstberg, Ontario.

L-O-F STAFF MEMBERS VISIT EUROPEAN GLASS AND CHEMICAL PLANTS

A group of six technical and operating men of Libbey-Owens-Ford Glass Company accompanied D. H. Goodwille, Executive Vice President, sailing from New York September 6 for a visit over a number of weeks to glass and chemical plants in England, Belgium, Germany, France, and Italy.

The party, besides Mr. Goodwille, included W. H. Hasselbach, Director of Engineering; Emmet L. Walters, Chief Mechanical Engineer; I. G. Fowler, Assistant Director of Development; D. W. Dunipace, Development Department; Delmar E. Carney, Rossford plant furnace superintendent; and C. W. Davis, Jr., technical assistant to Mr. Carney.

NPA ORDER ON COBALT

Section 5 of NPA Order M-80 allows cobalt to be used as a decolorizer for all glass and whiteware and as a colorant for signal and optical glasses.

If a manufacturer uses in excess of 25 pounds per month for these uses, he should seek allotment for his requirements on Form NPAF-114, to be filled as instructed in Section 3 of the order. Forms may be obtained from the nearest NPA regional office or from Ref: M-80 Schedule 2, National Production Authority, Washington 25, D.C.

Inventions and Inventors

Feeding and Forming

Press. Patent No. 2,565,155. Filed Sept. 6, 1947. Issued Aug. 21, 1951. Two sheets of drawings, none reproduced. Assigned to Emhart Manufacturing Company by Daniel B. Westin.

This is a device which can be incorporated into a machine identified by British Patent No. 560,672 of 1944 which appears to be a form of the Hartford I.S. Machine. It is adapted for making generally flat articles such as lamp bases, coasters, saucers, etc. The patent contains two claims and references cited were: 301,131, Kuntz, July 1, 1884; 417,306, Appert, Dec. 17, 1889; 424,331, Morton et al., Mar. 25, 1890; 1,037,841, Cuming, Sept. 3, 1912; 1,326,765, Miller, Dec. 30, 1919; 1,501,868, Said et al., July 15, 1924; 1,670,821, Pawling et al., May 22, 1928; 2,006,056, McNamara, June 25, 1935, and 560,672, Great Britain, Apr. 14, 1944.

Bottle Machine. Fig. 1. Patent No. 2,565,749. Filed Apr. 11, 1946. Issued Aug. 28, 1951. Three sheets of drawings. Assigned to S. & Z. Manufacturing Company by Anthony T. Zappia.

This patent relates to a drive mechanism for a two-table forming machine which may be somewhat like that shown in Patent No. 2,049,422 to Bridges. The mechanism includes a Geneva drive 18 which acts through gears 15, 16, and 17, the Geneva drive being operated by a rotator 24. The finish mold table is operated by connections from the plunger 10. Timing valves are provided so that the blank mold table and the finish mold table come to rest in exact positions which is essential for the successful operation of a two-table machine.

The patent contains six claims and the references cited were 1,796,992, Helm et al., Mar. 17, 1931; 2,015,662, Bridges, Oct. 1, 1935; 2,235,047, Sloan, Mar. 18, 1941, and 2,252,391, Benoit et al., Aug. 12, 1941.

Furnaces

Melting Furnace. Fig. 2. Patent No. 2,564,783. Filed Nov. 2, 1948. Issued Aug. 21, 1951. Three sheets of drawings. George E. Howard, inventor.

The figure shows a melting furnace 14 connected to a forehearth 15, the batch being received in the upper part 18. Exhaust flues 23 and 24 under the control of dampers withdraw some of the gases. Briquets C composed of lime, soda, and silica are fed in the form of lumps A of perhaps three inches in diameter. Cullet can also be supplied. The upward flow of heating gases is controlled by dampers 25 and 26. A zone 35 is called a "pastifyng" area. The molten produce passes into a pool 33 and then to the forehearth 15.

The patent contains seven claims and references cited were: 20,828, Powell, Aug. 16, 1938; 805,139, Hitchcock, Nov. 21, 1905; 1,217,340, Pease, Feb. 27, 1917; 1,610,376, Hitner, Dec. 14, 1926; 1,860,082, Drake; May 24, 1932; 2,284,398, Kutchka, May 26, 1942; and 2,294,373, Batchell, Sept. 1, 1942.

Glass Compositions

Glass-to-Metal Seal. Patent No. 2,564,950. Filed Jan. 31, 1947. Issued Aug. 21, 1951. One sheet of drawings, none reproduced. Assigned to Owens-Illinois Glass Company by Harold R. Black.

This is a glass for use in the manufacture of X-ray tubes and the like. It is said to take the place of three glasses that have been used for this purpose. The patent contains five claims and Claim 1 sets forth the invention as: A glass consisting of the following oxides and in substantially the following proportions, namely:

	Parts
Silica	64.90
Boric oxide	22.50
Iron oxide	0.08
Aluminum oxide	4.90
Sodium oxide	7.00
Cerium oxide	0.50
Antimony oxide	0.11

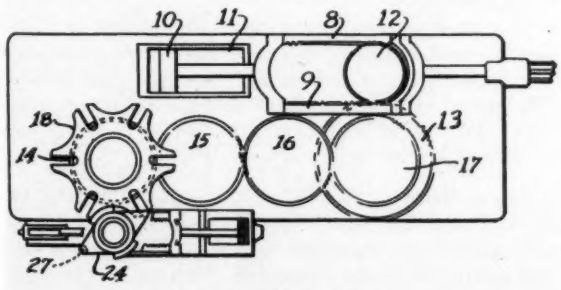

Fig. 1. Bottle Machine.

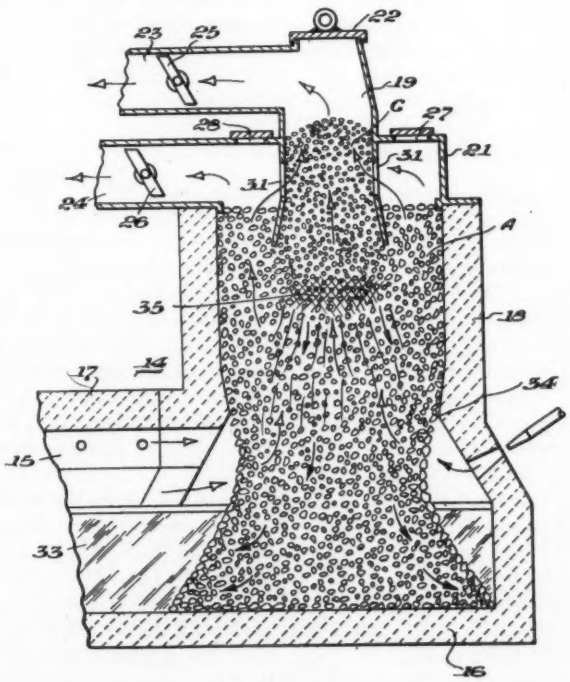

Fig. 2. Melting Furnace.

Eight references were cited: 1,545,509, Montgomery et al., July 14, 1925; 2,049,765, Fischer, Aug. 4, 1936; 2,071,196, Burger et al., Feb. 16, 1937; 2,167,482, Hull et al., July 25, 1939; 2,226,418, Tillyer et al., Dec. 24, 1940; 2,408,468, Lyon, Oct. 1, 1946; 2,426,472, Stanworth, Aug. 26, 1947; and Glass, The Miracle Maker, Pitman Publishing Co., New York, 1941.

Multicellular Glass. Patent No. 2,564,978. Filed March 7, 1946. Issued Aug. 21, 1951. No drawings. Assigned to Corning Glass Works by J. F. Hyde and S. D. Stookey.

This patent contains five claims, the last being as follows: A batch for a multicellular glass, which consists of an intimate mixture of a pulverized soda-lime silicate glass and 1.2% to 4.8% by weight of a finely divided amino compound selected from the group consisting of urea, biuret, thiourea, guanidine, cyanuric acid, and oxamide.

Glass for Illuminating Ware. Patent No. 2,566,134. Filed originally Sept. 12, 1946. Divided and this application filed April 11, 1951. One sheet of drawings, none reproduced. Assigned to Holophane Company by Isadore Mockrin and Arnold E. Pavlish.

This glass has a higher index of refraction than that usually employed in the manufacture of reflectors and the like. The patent contains one claim which is: A clear, substantially colorless glass for illuminating glassware reflectors with an index of refraction of 1.57 to 1.65, a specific gravity of 2.70 to 2.95 characterized by the absence of color selective and light scattering components and consisting of 40% to 65% SiO_2, alkali oxide component selected from the group consisting of Na_2O and K_2O and mixtures thereof in amounts of from 5% to 27.5% with not more than 12% K_2O, alkaline earth oxide component selected from the group consisting of CaO, MgO and BaO and mixtures thereof in amounts from 8% to 12.5%, an acid forming, high-index of refraction component amounting to from 10% to 30% of ZrO_2 and minor impurities not exceeding 2%.

The only reference cited was Eitel-Pirani-Scheel: Glastechnische Tabellen (1932), page 659.

Glass Wool and Fiber

Fiber Machine. Fig. 3. Patent No. 2,566,252. Filed Sept. 21, 1945. Issued Aug. 28, 1951. One sheet of drawings. Assigned to Owens-Corning Fiberglas Corporation by Fay V. Tooley and Robert G. Russell.

A batch press 10 extrudes a plastic rod 14 which includes a certain amount of binder. This rod is from 1/16 to 1/4 inch in diameter. The rod is delivered onto a guide 15 which terminates in a trough-shaped guide 16 of a material such as nickel. The latter guide is enclosed in an electrically heated melting unit 17. The stream of glass indicated at 26 is drawn or attenuated by a drum 27.

The general idea of the invention is to form the fiber directly from the glass batch. The patent contains three claims and the references cited were: 708,309, Bronn, Sept. 2, 1902; 946,179, Weiskopf, Jan. 11, 1910; 1,657,442, Miller, Jan. 24, 1928; 1,874,799, Peiler, Aug. 30, 1932; 2,018,478, Whittier, Oct. 22, 1935; 2,212,448, Modigliani, Aug. 20, 1940; 2,328,125, Buchsbaum et al., Aug. 31, 1943; and 481,690, Great Britain, Mar. 16, 1938.

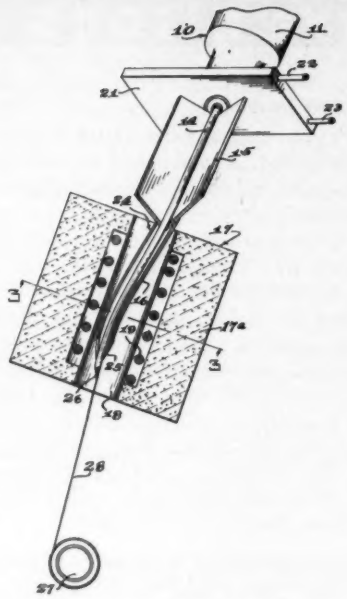

Fig. 3. Fiber Machine.

Glass Fiber Sheets. Fig. 4. Patent No. 2,565,941. Filed June 7, 1946. Issued Aug. 28, 1951. Three sheets of drawings. Assigned to Reconstruction Finance Corporation by Randolph H. Barnard.

This invention provides a machine and method of making semi-rigid or rigid boards of glass fibers. In the form of the invention shown in the figure, fibers are delivered from hoppers 41, 41a, and 41b onto a conveyor belt 43. The fibers from the different hoppers may vary in size or in other ways. Vapor barriers 54 are provided and heating hoods 46 and spray heads 55 and 53 may be used to apply treating material to the fibers. The mat then passes between rollers 48 and is severed into sections of the desired length by a knife 52.

The patent contains seven claims and the references cited were: 1,712,124, Stack, May 7, 1929; 1,940,975, Shaver, Dec. 26, 1933; 2,189,840, Simison et al., Feb. 13, 1940; 2,206,059, Slayter, July 2, 1940; 2,257,767, Slayter et al., Oct. 7, 1941; and 2,287,006, Kleist et al., June 16, 1942.

Miscellaneous Processes

Television Tube Machine. Patent No. 2,564,897. Filed June 22, 1949. Issued Aug. 21, 1951. Two sheets of drawings, none reproduced. George Hahn, Sharon Hill, Pa., inventor.

This machine comprises means for accurately positioning the head and neck of a television tube so that they will be welded together in the exact position desired. The patent contains one claim and the references cited were: 1,676,795, Mailey et al., July 10, 1928; and 1,788,954, Mailey et al., Jan. 31, 1931.

Ampul Machine. Patent No. 2,565,061. Filed Dec. 14, 1946. Issued Aug. 21, 1951. Two sheets of drawings, none reproduced. Assigned to Becton, Dickinson & Co., Rutherford, N. J., by Edward W. Bednarz.

This is a machine for making double-ended ampuls

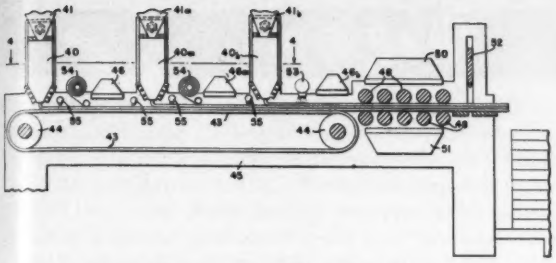

Fig. 4. Glass Fiber Sheets.

for medical use. These are made from glass tube so that the resulting ampul is open at both ends separated at the middle. Means for "tempering" and glazing is provided. A complete automatic machine is provided.

The patent contains four claims and nine references were cited: 1,055,402, Kimble, Mar. 11, 1913; 1,322,779, Frederick et al., Nov. 25, 1919; 1,817,826, Kee, Aug. 4, 1931; 2,103,585, Kimble et al., Dec. 28, 1937; 2,153,594, Saffir, Apr. 11, 1939; 2,227,224, Kimble et al., Dec. 31, 1940; 2,297,335, Wheaton, Sept. 29, 1942; 2,300,917, Gaskill, Nov. 3, 1942; and 117,427, Australia, Sept. 2, 1943.

Cathode Mount Machine. Patent No. 2,565,126. Filed Jan. 2, 1947. Issued Aug. 21, 1951. Two sheets of drawings, none reproduced. Assigned to General Electric Company by John Flaws, Jr.

This is a turret type machine having 24 heads. An exhaust tube is placed in a head at the first station together with the envelope tube and other necessary parts. The parts to be sealed are heated at a number of stations and the parts are brought together to seal them and the lead-in wires. Other stations provide for annealing the assembly.

The patent contains seven claims and the references cited were: 1,872,070, McCabe et al., Aug. 16, 1932; 1,933,323, Fagan, Oct. 31, 1933; 1,942,042, Zimber et al., Jan. 2, 1934; 1,990,258, Trutner, Feb. 5, 1935; 2,104,166, Pelton, Jan. 4, 1938; 2,153,370, Donovan et al., Apr. 4, 1939; 2,411,184, Beggs, Nov. 19, 1946; and 2,422,324, Watrous, June 17, 1947.

Fire Polishing Method. Patent No. 2,566,350. Filed Sept. 4, 1947. Issued Sept. 4, 1951. One sheet of drawings, none reproduced. William A. Meier, Rochester, Pa., inventor.

This invention proposes to give a polish to the gray surfaces left in decorated glass by the cutting wheel. This is done by passing the glass, while rotating, in front of heating burners which melt the finite parts making up the gray cut surface so as to make it transparent without materially heating the other part of the ware.

The patent contains one claim and the references cited were: 772,902, Nolan, Oct. 18, 1904; 1,178,256, Miller, Apr. 4, 1916; 1,577,581, Knight, Mar. 23, 1926; 1,667,146, Drake, Apr. 24, 1928; 2,044,566, Cory, June 16, 1936; 2,073,144, Darrah, Mar. 9, 1937, 2,371,486, Walker, Mar. 13, 1945; and 2,507,433, Borchert, et al., May 9, 1950.

Ampul Cutter. Fig. 5. Patent No. 2,566,434. Filed Apr. 17, 1948. Issued Sept. 4, 1951. One sheet of drawings. John J. Toth and Robert B. Lewis, inventors.

This is a hand tool for opening ampuls. The drawing is self-explanatory. The device is made of sheet material such as aluminum, shaped so that the jaws may be closed upon the ampul or vial in order that the cutter 25 can be pressed on the glass while it is turned. A gauge 30 is provided so that the point at which the cut is made can be located exactly.

The patent contains three claims and the references cited were: 454,233, Smith, June 16, 1891; 476,626, Fowler, Jr., June 7, 1892; 946,414, Wikander, Jan. 11, 1910; 1,170,588, Wells, Feb. 8, 1916; 1,538,903, Ogint, May 26, 1925; 2,224,354, Maxwell, Dec. 10, 1940; 2,410,901, Ramsey, Nov. 12, 1946; 2,447,988, Pierson, Aug. 24, 1948; 3,607, Great Britain, Mar. 28, 1891; and 608,020, France, July 13, 1926.

Glass Cutter. Patent No. 2,566,544. Filed Aug. 25, 1950. Issued Sept. 4, 1951. One sheet of drawings, none reproduced. Assigned to Red Devil Tools by Guy C. Wyman.

This invention provides a glass cutter in which the cutting wheel and axle may be conveniently replaced in exact position in a most economical manner.

The patent contains two claims and six references were cited: 742,179, Fletcher, Oct. 27, 1903; 766,827, Hughes, Aug. 9, 1904; 1,865,242, Eldredge, June 28, 1932; 1,870,585, Parks et al., Aug. 9, 1932; 2,096,284, Lee, Oct. 19, 1937; and 2,254,162, Wyman, Aug. 26, 1941.

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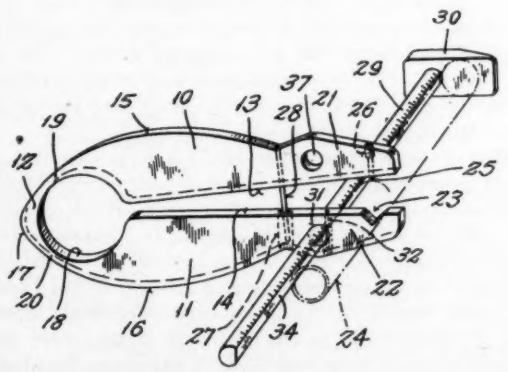


Fig. 5. Ampul Cutter.

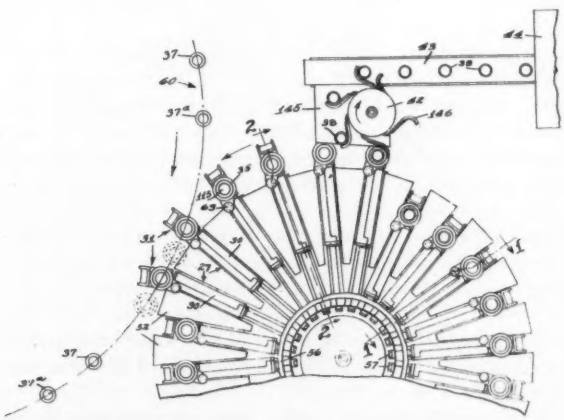


Fig. 6. Burn-off and Take-out Machine.

Research Digest

Use and Misuse of Fused Cast High-Alumina Refractories

Fused cast high-alumina refractories are comparative newcomers to the glass tank field. Since it is well-known that no refractory or group of refractories can meet every service condition and inasmuch as this particular group of refractories now have considerable service experience, Brown and Stach (*Bulletin of the American Ceramic Society*, August 1951) have analyzed some of the chemical and physical properties of high-alumina fused cast refractories as they relate to applications.

This group of refractories consists of three commercially available types: *Type H* — This mix is highly crystalline and white in color. It is composed almost entirely of β-alumina, a crystalline compound consisting chiefly of aluminum oxide. With the ingredients other than alumina and soda totaling less than 0.5% and with colorants such as iron oxide less than 0.06%, this material is virtually free from undesirable impurities. The interstitial glass content is less than 0.5%. *Type MH*— This is a modification of Type H, small amounts of silica and lime having been added at the expense of the soda for the purpose of modifying the physical properties. Beta-alumina crystals make up the chief portion of the structure but are broken up in size and continuity of alpha-alumina crystals. Containing less than 2% interstitial glass, its crystal content is approximately 60% β-alumina and 38% α-alumina. The structure is granite-like, has a high density, is white in color, and contains less than 0.06% iron. *Type K*— This mix contains about 80% alumina and is made by fusing alumina with a minor proportion of chromite. The primary crystal phase is a solid solution of alumina and chromic oxide, with a ground mass of high-alumina spinel.

This group of refractories was developed primarily for corrosion and erosion resistance, with the result that the refractories represent somewhat of a compromise with respect to thermal shock resistance. This is due to the dense, impervious structure and the interlocking crystal structure. Laboratory thermal shock tests evaluate the three types as follows: Type H, excellent; Type MH, fair; and Type K, fair to poor. Service results seem, in turn, to support these findings and point the way to the proper usage of these blocks.

Types MH and K are not generally suitable for use in day tanks, where the method of operation results in severe thermal shock conditions. The practice of making one or two charges of cold batch daily, the variations in glass level, and extreme time-temperature cycles combine to cause trouble. Thermal shock resistance is not ordinarily considered to be a prime requisite of continuous furnace refractories, except for a few limitations as, for example, the refractories in the immediate area of the doghouse. In some furnace designs, this area has been about as vulnerable as any in the tank proper. Cold air drift and cold batch combine to cause some temperature fluctuations. These conditions have resulted in cracking of K and MH in some cases.

It is conceivable that some furnaces pose operating conditions which can be handled by a combination wall of fused cast refractories backed up with bonded materials. However, insulation is not without its drawbacks, and such an operating practice comprises erosion resistance for improved thermal shock resistance. Fused cast refractories have a higher thermal conductivity than most bonded refractories used by the glass industry and actually have improved erosion resistance partly because heat can be dissipated more rapidly from the interface between the refractory and the glass bath. Insulation retards this phenomenon and will, therefore, have the effect of increasing the rate of erosion. The characteristic high-alumina composition provides a high-viscosity interface glass, but a higher face temperature on the block as a result of insulation will also reduce interface viscosity and increase the erosion rate. While the use of insulation does involve disadvantages, it may provide improved furnace efficiency, which may be desirable under circumstances where fuel economy is important. Generally, insulation will improve thermal shock resistance, but its use is usually not necessary as such cracking as has been observed has not unduly affected the service life of the refractory.

Type H has been universally applied in glass tank superstructures. Most applications are quite successful with the material being used for tuck stones, breastwall blocks, bridgewall covers, baffle blocks, shadow wall blocks, port arch and port neck assemblies, and closed doghouse arches. The temperature changes during reversals in regenerative firing are comparatively mild, and Type H possesses high thermal shock resistance for a fused cast refractory, along with its high refractoriness, low interstitial glass content, and resistance to flame abrasion, volatilized alkalis, and batch dust.

The unique resistance of this group of refractories to horizontal joint attack and upward drilling is the primary factor which has led to a new popularity for multiple course construction. Type K is more resistant to joint attack than Type MH, although this latter variety is superior to most available refractories. For this reason, Type MH can be very successfully used as the lower blocks of a two-course sidewall and it will also perform well in the metal line. However, care must be exercised in selecting the proper depth of the first course when MH is used in the melting zone. MH is satisfactory under all circumstances in the refining end. Here temperatures are lower and the combined erosion resistance and purity of Type MH are important factors. Due to the high resistance to joint erosion and upward drilling of the Type K. block, this type is being used for throat cover blocks and throat assemblies.

The presence of chromite in Type K is essential to the structure and attendant properties. However, chrome and iron in the refractory cause concern about possible coloration of certain types of glasses. In some instances, it is mandatory for tank operators and the refractory manufacturer to give considerable thought to the limits to which Type K can be safely used. The fields where such a study must be made are in those where the absence of color is desired. Type K can be used without

(*Continued on page* 534)

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during July 1951 reached a preliminary 121,200. Compared with the adjusted employment of 129,600 for June, this represents a drop of close to 6½ per cent. During July 1950 employment in the glass industry was 114,000, or about 6 per cent below July this year.

At the end of July 1951, glass manufacturers had paid out a preliminary total of $30,027,261 during the month. This represents a difference of close to 19 per cent when compared with adjusted payrolls for June of $36,958,896. Payrolls during July 1950 were $29,857,360, or not quite 1 per cent below July this year.

Glass container production, based on figures released by the Bureau of Census, rose a little during August 1951 to reach 10,575,070 gross. Compared with the previous month's production of 10,354,762 gross, July production is about 2 per cent higher. During August 1950 production of glass containers was 9,133,388 gross, which is about 15½ per cent below that of July this year. Total production during the January-August 1951 period has reached 83,809,917 gross, which is about 22½ per cent more than the 68,407,294 gross produced at the close of the same period in 1950.

Shipments of glass containers, after several months of leveling off, jumped during August to establish a new second high for a single month—10,822,367 gross. Compared with the previous month's shipments of 9,686,865 gross, this represents an increase of about 11½ per cent. During August 1950 shipments were 11,302,038 gross, which is the all-time high for a single month's shipments. This shipment figure is about 4 per cent above August's second high. Thus far during 1951, shipments of glass containers have reached a total of 80,222,707 gross. At the same time in 1950, shipments were 70,276,075 gross, which is a little more than 14 per cent less than 1951.

Stocks on hand at the close of August 1951 dropped a little from the 10,375,274 gross on hand at the close of July to reach 10,102,186 gross. At the close of August 1950 stocks had been 6,742,617 gross.

Automatic tumbler production rose almost 4½ per cent during August to reach 5,806,758 dozens compared with July production of 5,560,327 dozens. During August 1950 production was 6,547,730 dozens. Shipments, however, dropped 7 per cent to 5,330,843 dozens from the 5,733,180 dozens shipped during July. During August 1950 7,222,210 dozens were shipped. Stocks on hand rose to 12,255,662 dozens, or about 4 per cent above the 11,768,503 dozens on hand at the close of July. At the end of August 1950, stocks were 8,091,408 dozens.

Table, kitchen, and household glassware: Manufacturers' sales of machine-made table, kitchen, and household glassware during August 1951 were 3,506,491 dozens. This is a jump of almost 27 per cent over the previous month's sales of 2,766,096 dozens. During August 1950 sales were 3,670,616 dozens. At the close of the 12-month period ending August 1951, manufacturers' sales have reached a total of 40,563,756 dozens. This is close to 4 per cent above the 39,114,047 dozens sold at the close of the same period in 1950.

GLASS CONTAINER SHIPMENTS
(All figures in Gross)

	August 1951
Narrow Neck Containers	
Foods	1,124,883
Medicinal & Health Supplies	991,353
Chemicals, Household & Industrial	604,815
Beverages, Returnable	582,435
Beverages, Non-returnable	19,912
Beer, Returnable	378,722
Beer, Non-returnable	1,900,251
Liquors	565,876
Wines	239,601
Toiletries & Cosmetics	505,753
Sub-total (Narrow)	6,913,601
Wide Mouth Containers	
Foods	*2,658,851
Dairy Products	326,064
Medicinal & Health Supplies	289,628
Chemicals, Household & Industrial	117,142
Toiletries & Cosmetics	114,715
Packers' Tumblers	122,954
Sub-total (Wide)	3,629,354
Total Domestic	10,542,955
Export Shipments	279,412
TOTAL SHIPMENTS	10,822,367

* This figure includes Home Canning.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All figures in Gross)

		Production August 1951	Stocks August 1951
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	3,280,028	3,850,110
	Wide Mouth	*2,853,530	*3,578,509
Dairy Products		341,290	317,119
Beverages, Returnable		602,753	516,990
Beverages, Non-returnable		19,085	25,255
Beer, Returnable		448,516	274,803
Beer, Non-returnable		2,031,699	381,998
Liquors		665,527	713,186
Wines		222,750	318,223
Packers' Tumblers		109,892	125,993
TOTAL		10,575,070	10,102,186

* This figure includes Home Canning.

S.A.M.A. REPORTS INSTRUMENTS SALES

Sale of industrial and laboratory instruments and apparatus for the first half of 1951 was 44.5 per cent over the corresponding period a year ago, according to figures just released by the Scientific Apparatus Makers Association.

Sales reported for the first two quarters totaled $90,113,292, according to Kenneth Andersen, Executive Vice President of the Association. Mr. Andersen said that the figures are for the Laboratory Apparatus, Laboratory Equipment, Optical, and Industrial Instruments Sections of S.A.M.A. and do not include the Recorder-Controller Section, whose companies do not report sales figures, nor the Nautical, Aeronautical, and Military Section, whose members cannot report them.

Quick Magazine

President Lee W. Minton, of the Glass Bottle Blowers Association (AFL), examines some of the many unusual entries submitted to the union-sponsored Glass Hobby Contest. All items are made from discarded glass bottles and jars.

UNUSUAL ENTRIES IN GLASS HOBBY CONTEST

Interesting and unusual use for bottles and jars have been submitted in the nation-wide Glass Hobby Contest being sponsored by the Glass Bottle Blowers Association. With the deadline for the contest set for October 15, items and ideas for unusual vases, statuettes, aquariums, lamps, dolls, door stops, and goblets continue to be submitted to the GBBA offices.

It is requested by the contest officals that entrants send a *description* of their ideas to the Glass Hobby Contest, 1133 Broadway, New York, New York, with a sketch or snapshot if possible. The re-designed bottles or jars themselves should not be sent to contest headquarters.

NEW GLASS FACTORY PLANNED IN ISRAEL

Purchases of machinery and equipment for a $1,200,000 glass factory to be erected in Israel with American and local capital are being made in the United States, according to *Economic Horizons*, monthly publication of the Economic Department of the Jewish Agency.

The new plant, to be known as the Negev Glass Works, Ltd., is being established at Beersheba, biblical town and new capital of the Negev. The American group, which was organized by AMPAL-American Palestine Trading Corporation, has subscribed to 50 per cent of the capital, while the balance is being subscribed by a group of Israel investors.

Operations are scheduled to start within 18 months at a daily capacity of 60 tons, with provisions for the production of an additional 30 tons at a later date. Annual production of bottles, jars, and other containers, as well as domestic glassware, is planned to amount to 50,000,000 units, with fully automatic equipment from the United States. 90 per cent of the raw materials required are in ample supply within 20 miles of the factory and about 10 per cent (mainly soda ash) will have to be imported.

It was also reported that the expansion of an existing sheet glass factory near Haifa is now nearing completion. This plant, the Phoenicia Window Glass Works, Ltd., will have an annual capacity of 21,500,000 sq. ft. of window glass, as against the present output of 9,000,000 sq. ft. United States funds from the Export Import Bank loan are being used to finance part of this $2,000,000 expansion program.

OPS ISSUES ORDER ON GLASS VIALS AND AMPULS

The Office of Price Stabilization has announced a new order removing glass vials and ampuls from coverage under Ceiling Price Regulation 30 (machinery) and placing them under the GCPR which also governs the pricing of glass containers.

PRESSED AND BLOWN GLASS MANUFACTURERS MEET WITH NPA ON SELENIUM SITUATION

Representatives of the pressed and blown glass manufacturers (*this does not include glass container manufacturers*) met with officials of the National Production Authority to discuss problems arising from the current critical shortage of selenium and to explore methods of providing an equitable distribution of available supplies.

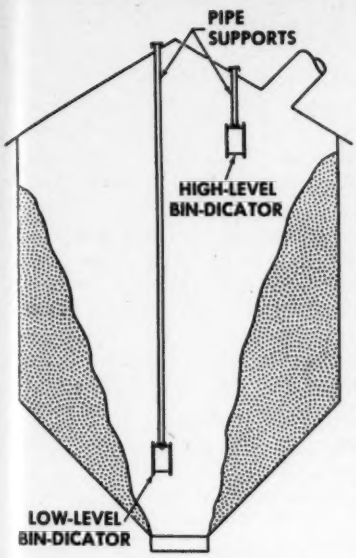
Manufacturers reported that there is no acceptable substitute for selenium in the manufacture of glass. Manganese has been tried but found to be largely unsuccessful. Experiments with other minerals also have proved unsuitable. A type of rare earth, cerium oxide, would be acceptable, but investigation has proved that there is not enough of it available to supply even one of the smaller glass plants for a year.

Manufacturers of table and crystal glassware said that any further limitations on the use of selenium would be injurious to their business and, in some cases, might lead to shutdowns. They pointed out that most manufacturers of such glass are small companies in localities where there are usually the sole industry in the town and, therefore, the principal source of the community's income. European competition has compelled a number of manufacturers of handmade glass to go into the production of colored glass for which selenium is essential. Any further reduction in selenium use would virtually force them out of business, they reported. These manufacturers consume 200 to 300 pounds of selenium annually.

NPA agreed to consider the manufacturers' recommendations.

• Battelle International, the new international resarch institute to be established in Europe this fall, will maintain laboratories and offices in several Western European countries, it has been announced.

New Equipment and Supplies



BIN-LEVEL INDICATOR

The Bin-Dicator Company, 13946-36 Kercheval, Detroit 15, Michigan, has a new, special model bin-level indicator designed to solve the problem of securing dependable level indication in large bins.

The new unit, known as Model CS Bin-Dicator, is being made for suspended installation from above and can thus be located anywhere in the bin where there will be a free flow of material to and away from the diaphragm. This flexibility as to location permits the successful application of this model in bins containing materials which tend to build up on the walls of the bin and to flow down through the central area only.

The unit is designed to be drilled and tapped to take any size pipe up to 2″. The support pipe also accommodates electrical wiring, making conduit unnecessary. Because of the manner of mounting, the installation can be easily moved up or down in the bin to operate at different levels or lifted out for inspection.

GRINDING WHEEL TRUING DEVICE

Norton Company, Worcester 6, Mass., has announced the development of an automatic grinding wheel truing device, wheel guard type, which is available for all Norton cylindrical grinding machines.

The device automatically performs angular, step, straight, or combination formed wheel face truing at the touch of a push button. The diamond truing tool, which is located inside the wheel guard above the wheel, makes a round trip at a predetermined feed and speed across the wheel face when the device is actuated through a push-button control. Changes in speed and feed are quickly made whenever desired. The rate of speed of diamond travel when not in contact with the wheel is automatically increased to reduce the over-all truing time.

PORTABLE LEAK LOCATOR

RCA Scientific Instrument Section, Camden, New Jersey, has announced a new, improved, portable high-sensitivity leak locator, designed as a factory and laboratory device for detecting and locating tiny leaks during the manufacture of electron tubes of all types, vacuum bottles, or any device, large or small, which can be evacuated.

A hydrogen-sensitive, ionization-type instrument, the new RCA leak locator, Type EMV-7, weighs only 31 pounds and is simple enough to be operated by non-technical personnel. The instrument is capable of detecting leaks as small as 1×10^{-5} liter-microns of hydrogen per second and the improved vacuum system can be pumped down, ready to operate, within two minutes.

The basic feature of the new locator is a sealed-off, high-vacuum-gauge tube, RCA type 1945, which responds only to hydrogen. The instrument itself is complete with a high-stability DC amplifier, microammeter, self-contained power supply, and all-metal exhaust system and cold trap. The instrument measures 13¾″ high, 15″ wide, and 11″ deep, overall. It operates from a 105-125 volt, 60-cycle, a-c line.

CATALOGS RECEIVED

Solvay Sales Division, Allied Chemical & Dye Corporation, Advertising and Sales Promotion Department, 40 Rector Street, New York 6, New York, is offering a new, completely revised edition of their Technical and Engineering Service Bulletin No. 9, "The Analysis of Alkalies".

The company advises that this third edition has been substantially enlarged and now contains 72 pages of text, tables, charts, and indexes. New additions or revisions include the recalculation of analytical factors to the basis of the 1948 International Atomic Weights, a colorimetric test for iron and copper, and a temperature correction table for volumetric solutions.

Carbide and Carbon Chemicals Company, 30 East 42nd Street, New York 17, New York, has published a new 8-page booklet devoted to the high-temperature applications of its UCON brand synthetic lubricants in glass and ceramics manufacturing.

The booklet includes a discussion of UCON advantages and gives details on how to use these synthetic lubricants in kiln car wheels, oven-chains and drives, hot flare cut-off and stem machines, and glass ribbon, blowing, and pressing machines, as well as on gears and bearings operating at high temperature. A complete list of UCON's properties is included.

Red Devil Tools, Irvington 11, New Jersey, has issued a new 96-page catalog, No. 21, covering all Red Devil products.

Profusely illustrated and designed for quick reference use, the catalog includes glass cutters and all types of glaziers' tools, putty knives and wall scrapers; glass, wood, and paint scrapers; masonry drills; etc. Displays and other merchandising aids are also described, as well as production specifications with directions and technical data relative to proper tool application and care.

Acheson Colloids Corporation, Port Huron, Michigan, has announced its Bulletin No. 427 devoted to glass mold sticking.

Glass mold sticking can be prevented by treating mold surfaces with a dispersion of colloidal graphite in oil. The over-all results are less scrap, improved luster of the finished product, and a reduced necessity for cleaning the mold.

Various applications, a detailed discussion, and advantages of "dag" colloidal graphite are included in the booklet.

Fisher Scientific Company, 717 Forbes Street, Pittsburgh 19, Pa., has issued a new edition of a reference manual describing the theory and practical application of gas analysis.

The 60-page manual discusses the theory of gas analysis and goes into detail regarding the procedures involved in the various analyses.

Libbey-Owens-Ford Glass Company, Glass Fiber Division, Toledo, Ohio, has compiled a pamphlet, entitled "Reinforcements", devoted to the specifications for the yarns and superfine fiber glass to be manufactured by the firm's new division.

The pamphlet lists 18 different yarns marketed in seven forms, and 22 different superfine fiber glass products in three groups suitable for aircraft insulation, life jackets and flotation equipment, and for automotive and refrigeration insulation.

EDWIN L. HETTINGER DIES

Edwin L. Hettinger, for more than 30 years Director of Optical Research at Willson Products, Inc., Reading, Pa., died on September 2 at the age of 72. He had been associated with the Reading firm, manufacturers of eye and respiratory protective equipment, for 38 years.

A specialist in the industrial applications of glass as an eye protective material, he was one of the pioneers in the development of the modern safety goggle, through his work on the now-universal process of heat-treating glass lenses to increase their impact resistance. In addition, he contributed to research on glass formulas providing cut-off of ultraviolet and infrared rays that resulted in the development of protective tinted glass for welders and others exposed to harmful forms of radiant energy.

Mr. Hettinger was a Fellow in the American Ceramic Society, and a member of the American Chemical Society, the American Standards Association, the American Society for Testing Materials, the Optical Society of America, the Sun Glass Institute, and the British Society of Glass Technology. He was a frequent contributor to technical journals of the glass and ceramic industry.

WAGE STABILIZATION BOARD APPROVES BOOST FOR GLASS CONTAINER WORKERS

A 5¢-an-hour wage increase and other benefits negotiated for workers in the glass container industry in April has been approved by the Wage Stabilization Board, it has been announced by Lee W. Minton, International President of the Glass Bottle Blowers Association (AFL).

The increase was agreed upon at wage reopening negotiations in Chicago by the G.B.B.A. and management representatives of all plants engaged in the manufacture of glass containers. The present wage boost brings total increases negotiated by the Union since July 1950 to 16½¢ per hour. The wage approval is retroactive to April 26, 1951. The current contract is effective until August 31, 1952, although provision is made for reopening of wage discussions after September 1, 1951.

ANCHOR HOCKING EXECUTIVE NAMED TO NPA

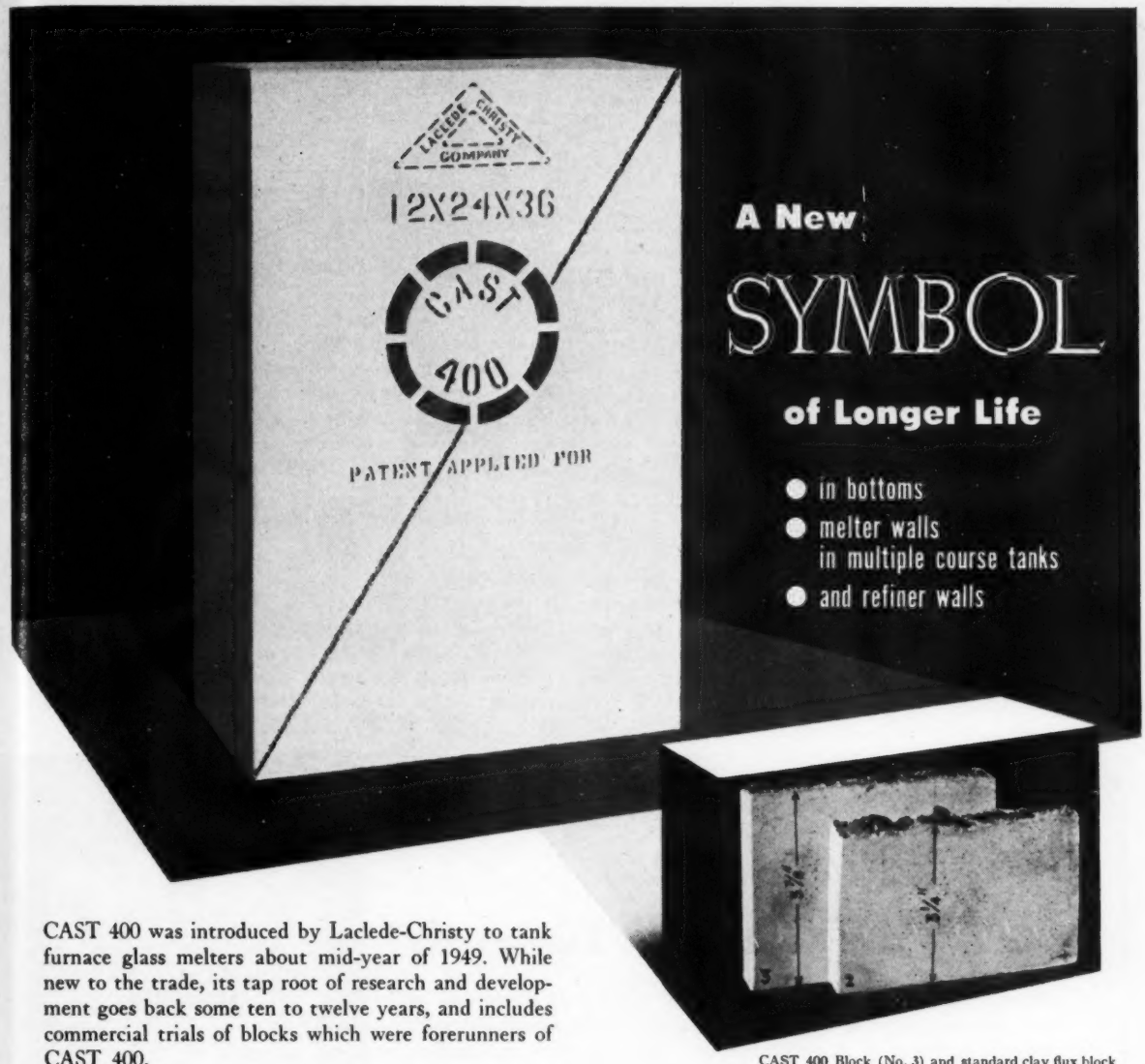
Frank Baumgardner, Manager of Market Analysis of Anchor Hocking Glass Corporation, has been appointed Chief of the Glass Container Section of the National Production Authority, Container and Packaging Division, in Washington.

Mr. Baumgardner has had nearly twenty years of industry experience in the field and in his company's general offices. He has been in charge of market analysis at Anchor-Hocking headquarters and before that, he was Assistant Sales Manager of the Container Division. He has also served as Branch Manager of the company's sales offices in Atlanta, Georgia, and Chicago, Illinois.

Bulk Loading Anhydrous Rasorite
BORON, CALIFORNIA
The increasing use of B_2O_3 by container ware plants indicates recognition of its merits as a minor constituent.
ANHYDROUS BORAX
ANHYDROUS RASORITE
BORAX—BORIC ACID
PACIFIC COAST BORAX CO.
Division of Borax Consolidated, Limited
New York • Cleveland • Chicago • Los Angeles
MANUFACTURERS OF THE FAMOUS "20 MULE TEAM" PACKAGE PRODUCTS

CAST 400 is manufactured at St. Louis, Mo.

Application for coverage of the trade mark CAST 400 and its manner of application has been filed with the U. S. Patent Office and an application for patent coverage has likewise been filed in the Patent Office.



CAST 400 Block (No. 3) and standard clay flux block (No. 2) were removed from the bottom of a revolving corrosion test furnace after being subjected to identical conditions. Blocks were originally 4 inches thick. The difference in the amount of wear will be readily noted and the striking difference in the transition layer between bottom glass and block will be readily apparent.

CAST 400 was introduced by Laclede-Christy to tank furnace glass melters about mid-year of 1949. While new to the trade, its tap root of research and development goes back some ten to twelve years, and includes commercial trials of blocks which were forerunners of CAST 400.

CAST 400 has a pronounced superiority over the older types of flux blocks in bottoms, in the lower courses of multiple course melting end walls, and in refiner walls in their entirety. In these locations it produces maximum results. It should not be used, however, in the melting end walls of continuous tanks at the metal line.

The outstanding features of CAST 400 are:

- Pronounced increase in service life.
- Not prone to pitting. The transition layer is smooth.
- Critical expansion points virtually eliminated.
- Takes heat up better.

CAST 400 is now in commercial service in many diversified types of tank furnaces including continuous container, fiber glass, flat glass and complete day tank flux requirements. Distinctive in appearance, each block carries a trade mark stencilled in bright red to make it easily identifiable in tank or warehouse. Also, a black refractory diagonal line further identifies the block so that it is not obscured by tank steelwork.

Test results shown here give you some of the relative merits of CAST 400. If you are interested in increased tank furnace life in bottoms, lower courses of melter walls and refiner walls, we would like to talk with you.

Cast Fluxtite Tank Blocks • Upperstructure Refractories • Glass House Specials
Pots • Firebrick and Cements • Silica Brick

Laclede · Christy Company

Glass Refractory Division: 4705 Ridgewood Ave., St. Louis 16, Mo.

CORNING DEVELOPS NEW PHOTOSENSITIVE GLASS COMPOSITION

A new kind of glass which can be precision-machined through the use of ultraviolet light, heat, and hydrofluoric acid to form intricately cut patterns of any desired shape and depth was described at the International Chemical Congress in New York City recently by S. D. Stookey, senior research associate of Corning Glass Works.

This new glass is the latest in a series of photosensitive compositions first announced by Corning in 1947 to produce permanent three-dimensional photographs in glass in a variety of colors. To the new composition, which is a special kind of photosensitive opal glass, Corning has adapted an equally new process of "chemical machining", which produces, without the aid of mechanical tools, lace-like patterns hitherto considered impossible in glass.

The first step in the process is the printing of a design in the glass using an ordinary photographic negative and ultraviolet light. Development is then accomplished by heating the glass to 1200°F. for the required length of time, usually about two hours. At this stage, a milk-white image appears in the otherwise transparent glass.

Next, the glass is immersed in a solution of hydrofluoric acid until the white areas are eaten through and removed, leaving the remaining unexposed glass in the exact form of the original pattern. By varying the length and intensity of light exposure through the photographic negative, the depth of acid penetration in the glass can be accurately controlled from shallow etching to complete erosion. In this way, sculptured figures or contoured shapes can be made by using a continuous tone negative with proper degrees of shading.

Since chemical machining involves no mechanical stress, patterns otherwise too complex to reproduce in glass or any other material without long and tedious work by skilled craftsmen can be simultaneously reproduced in any number and with photographic accuracy by this method.

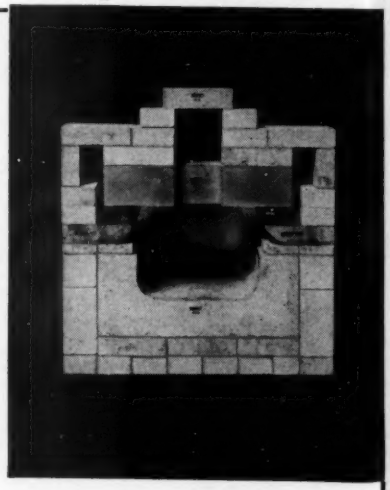
Chemical machining is especially suited to perforating holes of any shape having diameters of only a few thousandths of an inch and numbering up to several thousandths per square inch. Designs as irregular as lacework can be photo-etched as readily as simple straight line patterns.

The versatility of the process has already been demonstrated in the manufacture of "printed" electrical circuits for electronic instruments. By using a photographic negative, in a single operation a sheet of glass is cut into multiple pieces, each of proper shape and size and each having identically etched circuit patterns and holes for fastening to a chassis. The pattern thus photoengraved in each piece of glass is filled with conducting metals to form an electrical circuit of high precision and durability.

•Dr. A. C. van Dorsten, who was co-responsible for the design and development of the Philips Electron Microscope at North American Philips Company's research laboratories in Eindhoven, Holland, began a two-month lecture tour of the United States and Canada October 1.

Cleaner Glass, Low Maintenance

with **CRYSTALITE Forehearths**



REMMEY CRYSTALITE (mullite-bonded mullite) is produced in all shapes necessary to make up the forehearth assembly. Burner blocks, cover blocks, channels, spouts, tubes, plungers and orifice rings are built to meet specified requirements. These CRYSTALITE parts mean better, more efficient production by offering:

★ Accuracy in formation to eliminate time-wasting adjustments.
★ High refractoriness and erosion resistance for longer life, fewer replacement shutdowns and cleaner glass.
★ Rigid control through each production phase for uniform quality and dimension accuracy.

Get Premium Performance Without Premium Price . . . by using REMMEY CRYSTALITE parts for your forehearth.

Dependable Refractories

REMMEY

RICHARD C. REMMEY SON CO.
Philadelphia 37 • Pennsylvania

TAKE THE HAND OUT OF *Your till*

● Color problems can rob you blind. So take that hand out of your till. Cut production costs, save time and effort, too! Here's how: put Drakenfeld's friendly color service to work. Our staff of color experts and modern research laboratories are "on tap" to help you wipe the red off your books.

Drakenfeld tackles all kinds of color problems with an unrelenting thoroughness that can't be beaten. If you want colors duplicated or new ones formulated, if you want topnotch colors, coloring chemicals and supplies, if you want fewer rejects and better, more profitable ware, let Drakenfeld pitch in to help assure smooth production at lower cost. Learn how our step-by-step control of color manufacture can bring you the color quality, workability and every other essential you require. Let's get together for a discussion of your needs. Write or phone.

CALL ON **Drakenfeld** YOUR PARTNER IN SOLVING COLOR PROBLEMS

B. F. Drakenfeld & Co., Inc., 45-47 Park Place, New York 7, N. Y.

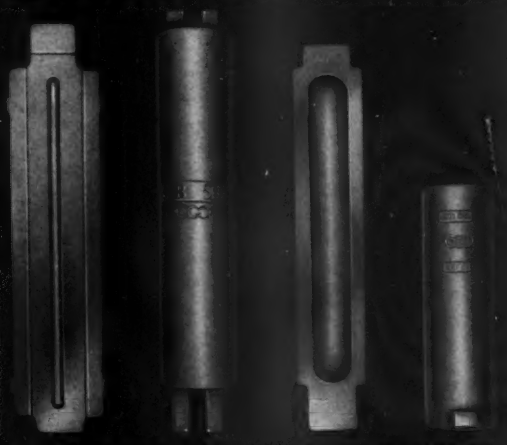
Factory and Laboratories: Washington, Pa.
Pacific Coast Agents: Braun Corp., Los Angeles 21,
Braun-Knecht-Heimann Co., San Francisco 19

DEPENDABLE SERVICE ON:

Acid, Alkali and Sulphide Resistant Glass Colors and Enamels . . . Crystal Ices . . . Squeegee and Printing Oils . . . Spraying and Banding Mediums . . . Glassmakers' Chemicals . . . Glass Decolorizers . . . Decorating Supplies.

GUNITE

RING STICKS



Ring Sticks are carefully cast to your specifications from your own patterns. Readily machinable.

BAR STOCK

Round bars in standard 14 inch lengths. 1/2 inch diameter to 5 inch diameter by 1/4 inch increments. ALL GUNITE castings are made of Gunite Metal suitably alloyed to provide the ideal glass house material. Gunite Metal is easily machined and readily polished to a mirror finish. Gunite Metal has maximum resistance to heat checking under the severe conditions imposed by glass making operations. You'll get superior service from GUNITE.

PLUNGERS

Standard plungers in all sizes from MG1 to MG10. Easily machined and polished to a mirror finish.

GUNITE FOUNDRIES CORPORATION
ESTABLISHED IN 1854
ROCKFORD GUNITE ILLINOIS

LEVIS AWARD FOR SAFETY . . .

(*Continued from page* 511)

1. All plants that qualify (beginning January 1, 1949) are eligible for the award.
2. No hernias are counted as lost-time accidents for this contest.
3. All questionable or borderline cases are sent to the American Standards Association's committee of judges for final decision.
4. The plaques are purchased and paid for by the General Industrial Relations Division.
5. The Safety Award tumblers are paid for by each individual plant.
6. In the event an injury is not a lost-time accident at the time it occurs, but later results in time lost or permanent partial disability, the accident is counted as of the first complete day lost or as of the date of the P.P.D. award instead of the actual date of the injury.
7. All amputations or disabling injuries which the plant knows to be lost-time accidents are turned in immediately in order to avoid confusion in figuring the date when a new accident-free period begins.

At the present time, some fifteen of O-I's 42 units have been awarded the Levis Safety Award plaques for their outstanding safety records. Seven thousand sets of award tumblers, decorated with the Green Cross for Safety, have been given to employees. The following plants have received the Levis Safety Award: Alton, Ill., Huntington, W. Va. (2), Streator, Ill. (2), Oakland, Calif., Bridgeton, N. J., Clarion, Pa., Fairmont, W. Va., Gas City, Ind., Charleston, W. Va., Alton Central Shops, Ill., Berlin, N. J., Warsaw, Ind., Vineland, N. J., Muncie, Ind., Sayreville, N. J., and Oakland C. M. S.

In the company's monthly publication, *Personnel Newsnotes,* which goes to all factories, the plants that have passed the half-way mark of their million manhours without a disabling injury are listed along with those that are eligible to receive the award, but whose records are still running. When a plant has already received one plaque and an accident occurs, a new string of accident-free days begins and this factory is then again eligible for another award when it qualifies.

Manner of presentation of the award is left to each plant. Some have parties and ask members of top management to give presentation talks to the Safety Committees. Others take time off for the entire personnel to see the presentation award.

But no matter how the award is presented, it is a main objective of Owens-Illinois to let its people know that management throughout the entire company appreciates their efforts in working safely—and the record speaks for itself.

WESTINGHOUSE LAMP APPOINTS TWO NEW MANAGERS

Two new appointments have been announced by the Bloomfield Lamp Division of Westinghouse Electric Corporation in its continued expansion program.

Harry A. Holden, with 22 years experience in lamp manufacturing, has been appointed Manager of the new Paris, Texas, plant that will start production by the end of 1951. The second appointment was that of Harry F. Fox, who succeeds Mr. Holden as Belleville Manager.

INVENTIONS AND INVENTORS . . .
(*Continued from page* 517)

Burn-off and Take-out Machine. Fig. 6. Patent No. 2,567,033. Filed May 23, 1947. Issued Sept. 4, 1951. Ten sheets of drawings. Assigned to Owens-Illinois Glass Company by Harold R. Schutz.

This machine is arranged to take blown articles, such as tumblers which are made two at a time, from the blowing machine, burn off the moil, and deliver them one at a time to a conveyor. The figure, which is a diagram, shows a blowing machine 60 having pairs of spindles 37 and 37a. A series of transfer cups 35 are rotated and projected radially at times so that a pair of cups are in position to receive two tumblers while travelling with the spindles 37 and 37a. These cups travel counter-clockwise and are rotated while passing burners which burn off the moil.

The finished ware is then removed by a transfer device 42 and placed in single file on a conveyor 43 which carries it to the lehr 44. Provision is made for all necessary adjustments and movements to carry out this cycle of operation.

The patent contains 14 claims and 14 references were cited.

Electrically Conducting Coating for Glass. Seven patents were issued Aug. 21, 1951 all relating to the same subject matter and all assigned to Corning Glass Works. While these do not relate directly to the manufacture of glass, they may be of interest to some readers who should order copies of the patents for full information. These patents are: James K. Davis, Inventor, 2,564,677; J. M. Mochel, Inventor, 2,564,706, 2,564,707, 2,564,708, 2,564,709, 2,564,710, 2,564,987.

LYNCH BUILDS LARGEST PRESS FOR MAKING GLASSWARE

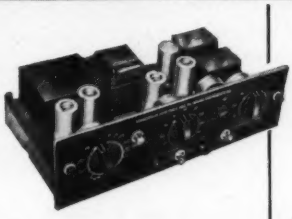
The Glass Machinery Division of the Lynch Corporation has announced the completion of the construction of two of the largest presses for making glassware that have ever been built. The machine, model "ELP", was built for the Corning Glass Works for the manufacture of extremely large pressed ware.

The "ELP" is a 120-ton toggle press with an all-over height of 14 feet, 5 inches. The table for this machine is 10 feet in diameter. It is an 11-station press that will produce glassware at approximately 15 pieces per minute, according to the company's announcement.

The toggle press stroke of the machine is adjustable from the floor by remote control while the machine is in operation. It has a 16-inch diameter inlet for the table cooling. The table is driven by two ten-inch diameter air cylinders in tandem, and one seven-inch booster cylinder. The chord dimension from mold to mold is 29 7/8 inches. The distance from the table to the plunger adaptor on the press cylinder has a minimum height of 13⅛ inches, and a maximum height of 52⅝ inches.

Machines of this size can produce glassware of approximately 27 inches in diameter, or width. The length of the articles to be made could be greater, depending upon the shape of the glassware to be produced. Such articles as punch bowls, large glass trays, TV face plates and funnels, platters, "Pyrex" ware, refrigerator trays, and extra large lenses can be manufactured on this machine.

Here's better control
for your
FURNACE or PROCESS



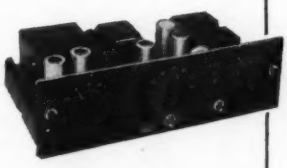
Temperature Record | Fuel Rate

Electr-O-Line

Electric Proportional Control Relay
With Automatic Reset

Position-proportioning control with automatic reset . . . Electr-O-Line.

The Electr-O-Line delivers a continuous heat input which is modulated according to exact process requirements. Individual control adjustments are included for proportional band, reset rate, approach rate and sensitivity. For complete information write for Specification Number 194.



Temperature Record | Fuel Rate

Electr-O-Pulse

Electric Proportional Control Relay
With Automatic Reset

Time-Proportioning control with automatic reset...Electr-O-Pulse.

The Electr-O-Pulse delivers an intermittent full heat input which is modulated on a pulse/time basis according to exact process requirements. Individual control adjustments are included for proportional band, reset rate, approach rate (optional) and cycle time. For complete information write for Specification Number 195.

Electr-O-Line and *Electr-O-Pulse* proportional control relays provide the sensitivity and accuracy required for the most critical control. Control adjustments are totally independent.

Both are available mounted integrally with the *ElectroniK* proportional controller, or separately for modernizing existing installations.

Your local Honeywell engineer can recommend control systems to suit your specific requirements . . . call him in today. MINNEAPOLIS-HONEYWELL REGULATOR Co., 4479 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
Brown Instruments

FERRO APPOINTS TECHNICAL DIRECTOR

L. Dow Moore has been named Technical Director of Ferro Corporation's newly-formed Fiber Glass Division at Nashville, Tennessee, where a new plant is now under construction.

As an associate research chemical engineer at the Midwest Research Institute, Mr. Moore helped develop several processes for the manufacture of fiber glass. He has also been associated with Koppers Company. He is a graduate of the University of Missouri.

HAZEL-ATLAS NAMES CHICAGO SALES MANAGER

Hazel-Atlas Glass Company has announced that Carl F. Haberstick has been named to be in charge of the company's Chicago Sales Office, succeeding G. M. VanKirk, who is retiring.

Mr. VanKirk has been connected with the firm for 45 years, 27 of which were spent in Chicago at the head of that office. Mr. Haberstick has been with the firm for 34 years, being associated with the Chicago office for 25 years.

A.S.T.M. ANNOUNCES 50TH ANNIVERSARY MEETING

Announcement has been made of the plans of the American Society for Testing Materials to hold its 50th Anniversary Meeting in New York City, June 23 through 27, 1952.

Special events are being planned and a General Committee on Arrangements has been appointed. It is expected that there will be groups of papers and symposiums on the following subjects: fretting corrosion, synthetic fibers, adhesives, direct shear test of soil, exchange phenomena in soils, continuous analysis of water, plastics, conditioning and weathering, methods for determining elastic constants, light microscopy, fatigue, effect of temperature, tin.

GLASS TEXTILE MANUFACTURER ACQUIRES INDUSTRIAL TAPE COMPANY

Hess, Goldsmith & Company, Inc., weaver of glass textiles, has contracted to acquire the assets of Horace Linton & Bros., Inc., of Philadelphia, pioneer manufacturer of industrial tape.

The purchase will be made from the stockholders of the Linton company, which was founded in 1897. Hess, Goldsmith is a major supplier of broad glass fabric to the electrical, plastics, aircraft, automotive, rubber, coated fabric, and chemical industries. It has several Air Force, Army, and Navy prime contracts and sub-contracts.

BORAX

Anhydrous and Technical

• • • **One of the original producers of anhydrous borax offers bag or bulk carloads to the Ceramic Industry. Stauffer's Borax is dependable and trouble-free.**

TYPICAL ANALYSIS	ANHYDROUS	TECHNICAL ($Na_2B_4O_7 10H_2O$)
Sodium Borate ($Na_2B_4O_7$)	99.25 to 99.50%	52.85 to 54.32%
Boron as B_2O_3	68.00 to 68.89%	36.75 to 37.74%
Chlorides as NaCl	0.10 to 0.16%	0.04 to 0.08%
Iron as Fe	30 to 35 Ppm	2 to 8 Ppm
Arsenic as As_2O_3	20 to 40 Ppm	3 to 8 Ppm
Sulphates as Na_2SO_4	0.3 to 0.4%	nil
Carbonates as Na_2CO_3	nil	nil

•

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Ever since their introduction, "Duro-Glo" Glass Colors have enjoyed outstanding acceptance by the trade. Actual performance results prove "Duro-Glo" to be the finest colors ever developed for squeegee application on commercial glasses.

Many of the country's leading container manufacturers have found these superior glass colors provide the answer to their requirements for superior ware with more eye appeal and fewer rejects.

Not affected by normal lehr temperature fluctuations, "Duro-Glo" Colors may be safely applied and fired at both the low and high temperature limits without blistering of color, deformation of glass or chain marks.

They give an extremely stable color with a high gloss and opacity never before provided by colors of this type. Why not let us demonstrate what "Duro-Glo" Colors can do for your ware!

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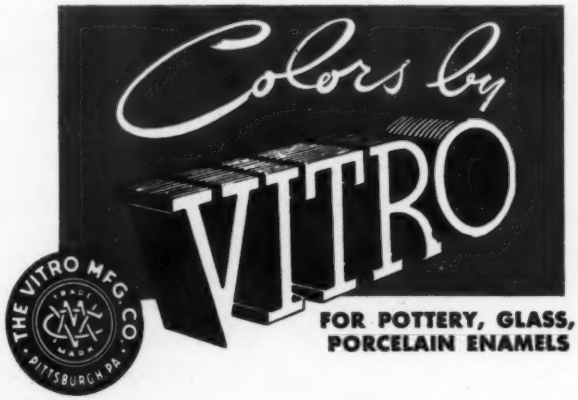

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RUSSIAN TRANSLATIONS . . .
(*Continued from page* 513)

This means, e.g., that kaolin bar of 1000 millimeters at 20° was 1004.97 mm. long at 1100° (because $460 \times 10^{-8} \times 1080$ is 497×10^{-5}).

The two "dinas" materials tested had the following compositions:

	Dinas sp. gr. 2.48	Dinas sp. gr. 2.35
SiO_2	95.24	95.86
Al_2O_3 TiO_2	1.50	1.60
Fe_2O_3	0.30	0.22
CaO	2.82	2.26
Na_2O	not detd.	0.10

Their coefficients of expansion were smaller the higher the temperature. They were:

	Dinas sp. gr. 2.48	Dinas sp. gr. 2.35
between 20° and 500°	2360×10^{-8}	2400×10^{-8}
between 20° and 800°	1750×10^{-8}	1650×10^{-8}
between 20° and 1100°	1240×10^{-8}	1150×10^{-8}

The heavier material also showed a marked volume change between 500° and 600°C., corresponding to the transformation β-quartz → α-quartz.

The mullitic refractory used contained a vitreous phase in addition to mullite (48 vol. %), corundum (18 vol. %), and ilmenite. The compositions of the refractory (specific gravity 2.64) and of the vitreous phase in it were:

	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	ZrO_2	Na_2O+K_2O
Refractory	22.58	65.99	3.28	3.00	1.18	0.40	3.31	1.09 %
Vitreous phase	64.69	11.82	3.00	2.04	8.80	1.41	1.19	7.05 %

The coefficient of expansion of the refractory was about 600×10^{-8} at room temperature and about 800×10^{-8} at 700°C. This coefficient for the vitreous phase had approximately equal values below 550°C. but rapidly increased on further heating; it rached 2600×10^{-8} at 700°C. This great difference between the thermal expansions of the whole refractory and one of its constituents must cause dangerous stresses in mullitic blocks during their heating.

The two corundum refractories tested had the following compositions:

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O
"O"	5.71	93.22	0.05	0.84	0.35	1.38%
"K"	7.74	90.03	0.05	0.59	1.67	1.35%

Their expansion coefficients were:

	"O"	"K"
between 20 and 500°C.	760×10^{-8}	677×10^{-8}
between 20 and 800°C.	790×10^{-8}	735×10^{-8}
between 20 and 1100°C.	860×10^{-8}	790×10^{-8}

The expansion coefficients of a porcelain tube were 386×10^{-8} between 20 and 500°C., 410×10^{-8} between 20 and 800°C., and 463×10^{-8} between 20 and 1100°C., i.e., almost equal to those of kaolin.

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MORE ABOUT WEST COAST MEETING

Supplementing the general announcement which was reported in the September issue of THE GLASS INDUSTRY, specific papers of interest to the glass industry to be presented at the forthcoming Pacific Coast Regional Meeting of the American Ceramic Society and their authors are: Production of High Grade Silica Sand in Nevada, by Fred L. Morledge; Exploration with the High Temperature Microscope, W. B. Franck; Some Common Sources and Causes of Stones in Glass from Continuous Furnaces, A. K. Lyle & A. L. Braken, Jr.; Amber Color Control in Electric Melting, H. Larry Penberthy; Differential Thermal Analysis as a Research and Control Tool, Joseph Pask; Some Aspects of Vibrational Comminution of Resistant Ceramic Materials, R. W. Van Fossen and H. J. Kelley; The Glass Industry in Mexico, Rodolfo L. Garcia; Human Engineering in Glass Container Manufacturing, J. H. Pettker; Mobility of Ions in Glass, W. D. Smiley; The Viscous Behavior of Glass, Howard H. Lillie; The Petrology of Fusion Cast High Alumina Refractories, H. N. Baumann; The Economic Status of the Glass Container Industry, R. L. Cheney; Light Transmission Characteristics and Dielectric Constants of Some Phosphate Glasses, Karl A. Janson & W. J. Knapp; Simple Analysis For Iron In Glass Raw Materials, H. Larry Penberthy & James I. Mueller.

AMERICAN OPTICAL DEVELOPS IMAGE-CORRECTING LENS

The development of a giant image-correcting lens for projecting improved 15-by-20-foot television pictures on movie screens has been announced by American Optical Company.

The new lens, more than 22 inches in diameter and made from special glass, is manufactured according to a technique devised by American Optical scientists during World War II for the production of Schmidt-type lenses incorporated in military optical instruments.

Special events or broadcasts are transmitted by private wires or radio beams to theaters where they are received by a kineoscope, or television picture tube. The tube is small—only a few inches in diameter—but it produces images of high brilliance. These are magnified to 15-by-20-feet by Schmid type optical systems like those used in the finest astronomical telescopes.

The optical systems include a 26- or 27-inch sperical mirror and one of the new lenses. The mirror, also made by American Optical, magnifies the television pictures and projects them onto the screen. Distortions introduced by the magnification are corrected by the image-correcting lens so that the pictures are normal and in perfect focus on the screen.

KERR GLASS TO MOVE HEADQUARTERS

Announcement has been made of the leasing by the Kerr Glass Manufacturing Company of space in the first of three 12-story air-conditioned office buildings under construction at 3440-50-60 Wilshire Boulevard, Los Angeles, California.

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INSTRUMENTATION AT DIAMOND . . .
(*Continued from page* 510)

Fig. 9. Glass level recorder-controller.

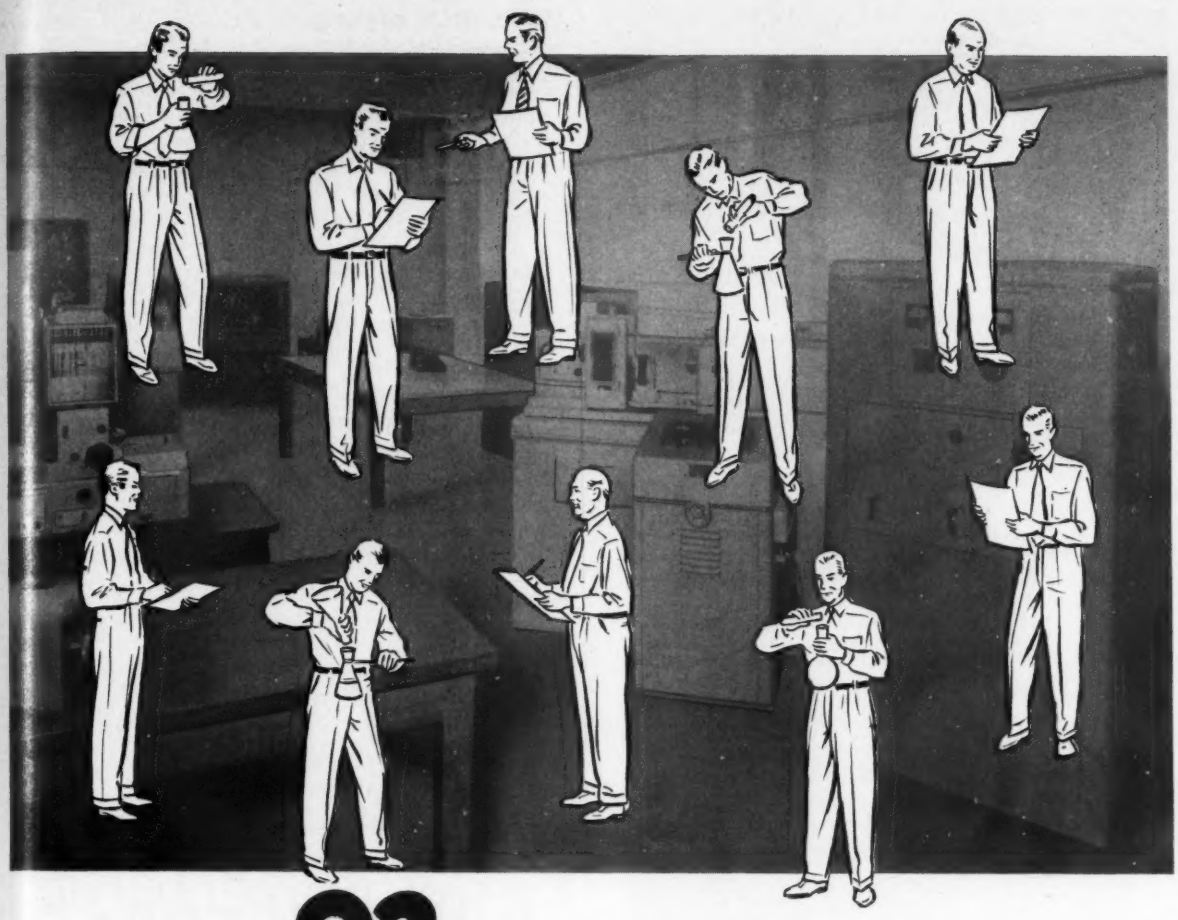
portant part of the process because it is here that much of the required physical qualities are imparted. Stresses and strains built up in the forming process are relieved, and the containers gradually cooled to handling temperature. Each lehr has nine zones of control through which the containers are carried on an endless belt. The Hartford-Empire lehrs are propane fired with non-indicating contollers regulating the gas to the burners. A millivoltmeter indicator and nine-point selector switch provide a means of checking zone temperatures which are logged hourly.

Inspection and Packaging

Last, but not least, is the packaging operation. A group of trained men and women inspect and check each container for color, flaws, and vital sizes. Rejects go to the cullet storage, while those that are perfect in every respect are placed in customer cartons and shipped by rail and motor freight to his plant for filling.

Except for inspection and packing, the last step, as can be seen every effort is made to utilize automatic controls to the fullest extent. Temperatures, flows, and pressures are automatically measured, controlled, and recorded to reduce the possibility of human error. The result is a glass, crystal clear and flawless, of exact weight and size, and produced with the utmost efficiency.

•Additional manufacturing facilities have been leased by the Raymond Corporation (formerly LYON-Raymond Corporation) in Morris, New York. The new Raymond plant will increase the firm's production facilities by approximately 70 per cent.



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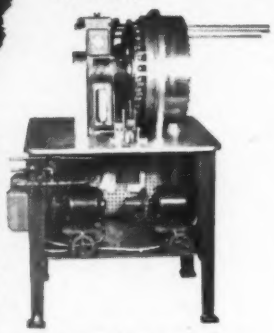

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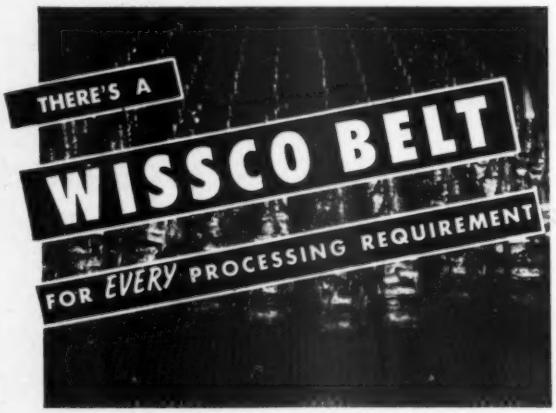

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RESEARCH DIGEST . . .

(*Continued from page* 518)

reservation for amber, blue, ruby, emerald, light green, and other colored glasses. On the other hand, Type MH is recommended *in toto* for crystal ware.

A search of the literature and consultations with glass technologists on this subject of the effect of chrome on color indicates that up to 0.001% Cr_2O_3 may be present in a soda-lime glass without giving the glass a noticeable color effect. This figure takes into account the Fe_2O_3 normally present and the definite undesirability of using additional decolorizers. To be on the side of safety, all color potential analyses made in conjunction with the use of Type K block are on the basis of the very conservative limit of 0.0005% Cr_2O_3.

From a careful study of a tank, its history and operating characteristics, it is possible to predict with accuracy the coloration potential using Type K. Using conservative estimates to provide an added safety factor, the amount of Type K that will go into solution during a projected campaign period can be determined by erosion charts, photographs, etc. For example, in one actual installation, the following observations on a flat glass tank were made: (1) An average of 37% of the Type K blocks used went into solution. (2) Since 30.3 tons of Type K were used in this installation, 11.2 tons of the material went into solution. (3) Because Type K contains a maximum of 9% Cr_2O_3 by weight, 101 tons of Cr_2O_3 entered the glass. (4) The tank produced approximately 102,600 tons of glass. (5) The calculated average Cr_2O_3 pickup by the glass, therefore, was

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0.0009%. (On a previous campaign, this manufacturer had used the same Type K metal line and had the glass analyzed for Cr_2O_3 at regular intervals. These tests showed a steady Cr_2O_3 content of 0.0008%, which compares well with the calculated figures.)

Another situation to consider is that, under most operating conditions, continuous furnaces develop "dead glass" on the furnace bottom or in the corners. This "dead glass" is contaminated by metallic inclusions, colorant oxides, and other batch impurities, as well as some impurities from refractory solutions. This predominately dormant glass may be disturbed by significant changes in pull, batch, temperature, and other operating practices, temporarily resulting in brown, gray, green, water-white, and other type streaks in the finished products. Although chrome from K goes into solution evenly, some may lodge in the "dead glass" which, when disturbed, could cause chrome-containing streaks. Experience has indicated that the reject count from this defect is no higher when Type K is used in the tank.

From the consideration of Type K, it is apparent that limits of usage are flexible and yet can be made specific to any set of conditions. The several operational and economic advantages prompt this kind of approach. Fortunately, Type MH supplies the ideal refractory and tank balance when the limit of Type K usage is reached. A combination of MH and K provides balance with high erosion resistance, excellent glass color and quality, and comparatively low refractory costs per ton of glass melted.

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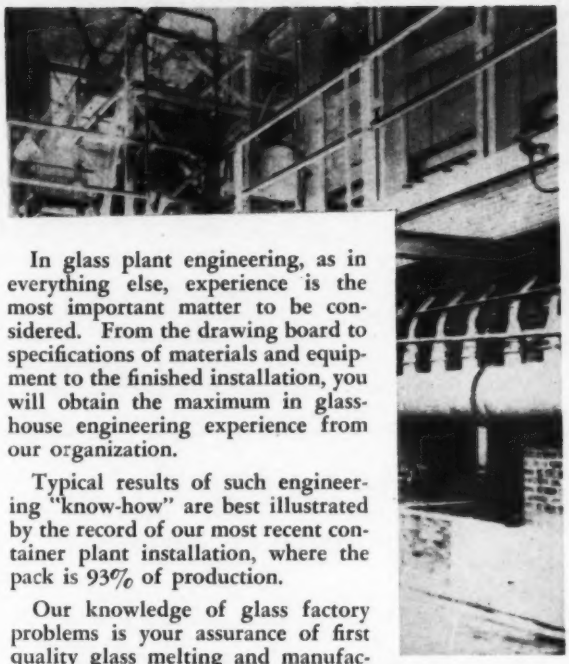

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